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Open File Report 6002

Upper Vermilion River Watershed: Stream Sediment, Outwash, Till and Esker Sediment Sampling Survey

by

P.J. Barnett

2000

Barnett, P.J., 2000. Upper Vermilion River watershed: stream sediment, outwash, till and esker sediment sampling survey; Ontario Geological Survey, Open File Report 6002, 75p.

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Barnett, P.J. 2000. Upper Vermilion River watershed: stream sediment, outwash, till and esker sediment sampling survey; Ontario Geological Survey, Open File Report 6002, 75p.

100-05546/

Contents

TABLES

FIGURES

Abstract

The Vermilion River has a long history of being investigated for its potential to host deposits of placer gold. The Vermilion River, located in northeastern Ontario, is a typical stream system in the Canadian Shield where bedrock topography creates numerous lakes and swamps along the drainage network. The main goal of the current project is to sample stream sediments within the watershed in order to re-evaluate the placer gold potential and locate possible bedrock sources for the placer gold within the Upper Vermilion River watershed of northeastern Ontario.

In designing the project, GIS was used to assist in developing a sampling strategy. A hydrologically-correct digital elevation model (DEM) with a spatial resolution of 30 m was created from 22, 1:20 000-scale digital Ontario Basic Mapping (OBM) maps with a contour interval of 10 m. Watershed basin analysis was performed using various ArcInfo GRID™ programs. Additional data on drainage, transportation and cultural features derived from OBM maps, bedrock geology, mineral occurrences and Quaternary geology were incorporated as layers into the GIS to aid in site selection and in the interpretation of sample results. Various queries were run to determine locations for sampling so as to optimize time in the field and reduce field expenses. Factors considered at a regional scale included: sub-basin representation; geological materials; and length of stream above a lake or swamp. At a local scale, stream gradient and the locations of riffles/rapids were considered. The prediction of sample site locations using GIS was very helpful in the initial stages of project planning. It provided targets for which daily field traverses could be planned.

Heavy mineral concentrates from stream sediment, outwash, ice-contact stratified deposits associated with eskers and till were processed for gold and selected samples for kimberlite indicator minerals (KIMs) and metamorphosed/magmatic massive sulphide indicator minerals (MMSIMs®). Concentrations of gold grains in the various sediment types analysed are for the most part low. They appear in general to be too low within the outwash sediments sampled to be economically viable as a placer gold source. However, as a by-product of mineral aggregate extraction, gold extraction may be economic. Several areas of possible interest are flagged by this study and might warrant follow-up.

KIM results are not as promising. However, one sample, 98-PJB-50-1-1, did contain several KIMs including 3 "G9" pyrope garnets. This sample's location near several intersecting faults is of interest.

The pyrite-assemblage of the MMSIMs is also interesting. It may be the result of unmapped iron formation subcrops, however, most samples occur north, up flow, from the known zone of this rock-type's outcrops.

Upper Vermilion River Watershed: Stream Sediment, Outwash, Till and Esker Sediment Sampling Survey

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Open File Report 6002
2000

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Introduction

The Vermilion River, located in northeastern Ontario, has been investigated for its potential to host deposits of placer gold several times in the past (Gracey 1898; Coleman 1901; Prest 1949). The abundance of "colours" in pans has maintained the interest in gold exploration along the Vermilion River for more than 100 years. The main goal of the current project was to sample stream sediments within the watershed in order to re-evaluate the placer gold potential and locate possible bedrock sources for the placer gold within the Upper Vermilion River watershed. The project is also evaluating the use of GIS to predict sample site locations and aid in the interpretation and presentation of survey results.

The Upper Vermilion River (Figures 1 and 2) is a typical stream system in the Canadian Shield, a deranged stream, where bedrock topography creates numerous lakes and swamps along the drainage network. In regard to stream sediment sampling, these features act as sediment traps and prevent or hinder the transport of heavy mineral grains along the stream system. In addition, point bars, which are common stream sediment-sampling sites along rivers in other terrain, are poorly developed along this river system. As a result, riffles were one of the prime sediment sampling site targets.

The methodology used in this project could be applied to stream sediment sampling surveys in the search for minerals and mineral potential evaluations of greenstone belts in more remote regions of the Canadian Shield.

Geological Setting

BEDROCK GEOLOGY

The Upper Vermilion River watershed is approximately 660 km^2 in area. It is underlain by rocks of Precambrian age (Figure 3). Meyn (1970, 1971, 1973 and 1976) and Dressler (1982) have completed bedrock mapping of the area. A short summary taken from their works is presented below. Figure 3 is a generalized version of a compilation map (Figure 4, back pocket) created for this project from the existing bedrock geology maps of the area (Meyn 1970, 1971, 1973, 1976 and Dressler 1982).

Archean metavolcanic and metasedimentary rocks, consisting of mafic and felsic flows, iron formation and metasedimentary schists and conglomerates are the oldest rocks exposed within the watershed. Granitic rocks (granite, quartz monzonite, granodiorite, and pegmatite) have intruded these rocks. Mafic dikes have subsequently intruded all of these older rocks. The Proterozoic (Huronian Supergroup) metasedimentary rocks unconformably overlie the above-mentioned rock sequence. The Huronian Supergroup includes the Mississagi Formation (quartzites); the Bruce Formation (paraconglomerate); the Gowganda Formation (argillite, siltstone, minor quartzite and paraconglomerate); and the Lorrain Formation (quartzite) (Meyn 1973).

The entire sequence has been intruded by dikes and sills of Nipissing-type quartz diabase, the Sudbury Nickel Irruptive and olivine diabase. All the rocks have been folded and faulted. Rocks of the Sudbury Igneous Complex and the Whitewater Group underlie the very southern part of the watershed. Gold has been reported to occur at the contacts between Nipissing gabbro and Huronian metasediments (Dressler 1982) and within shears in Nipissing-type diabase (Meyn 1971).

QUATERNARY GEOLOGY

Bedrock lithology and structure played a key role in the evolution of the area's landscape (Figure 4; back pocket). The landscape is strongly bedrock controlled with glacial sediments occurring commonly as thin discontinuous deposits (map units 1, 2 and 3, Figure 5; back pocket) in upland areas and as thicker deposits within the bedrock-controlled valleys.

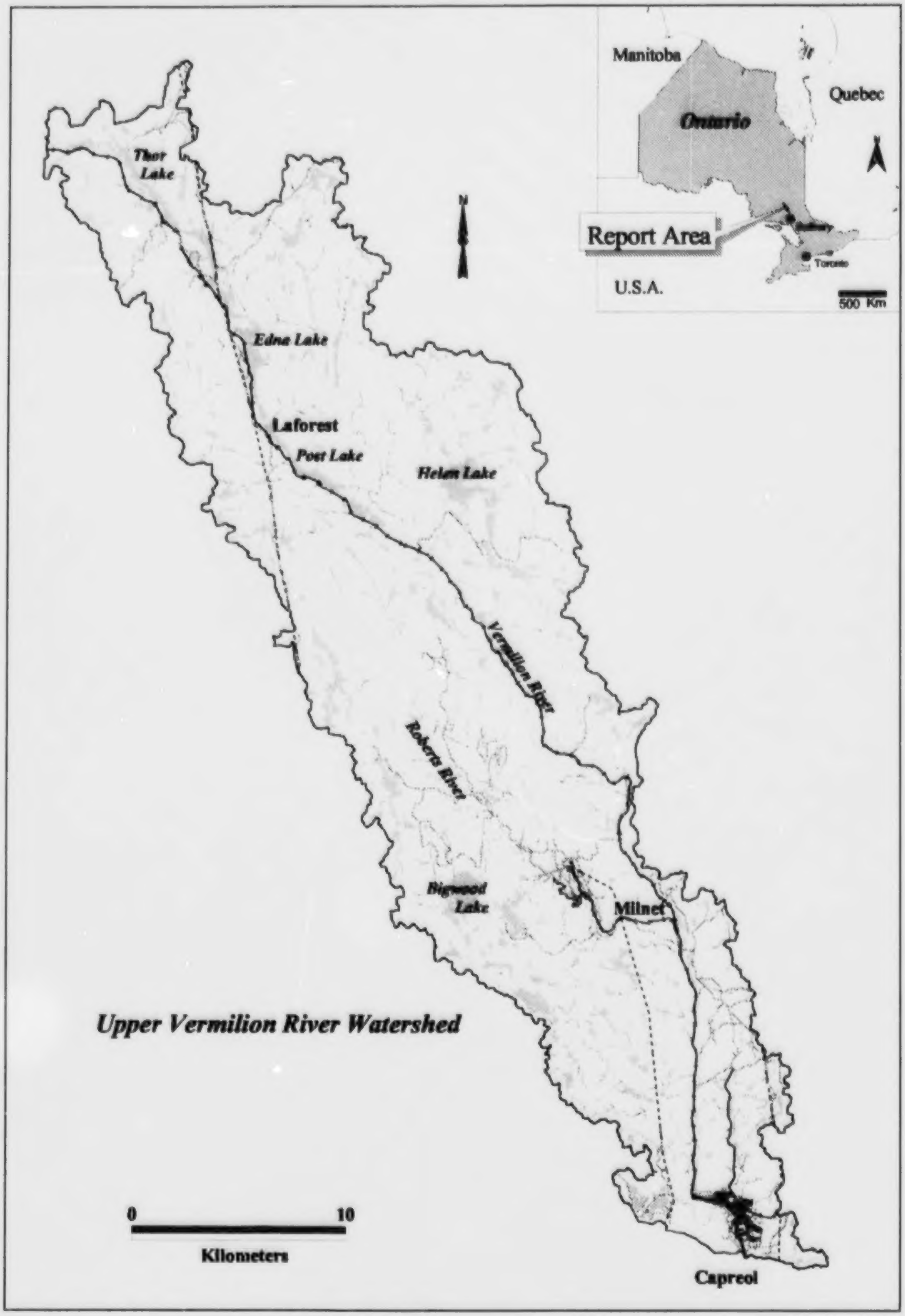

Figure 1. Location of the report area.

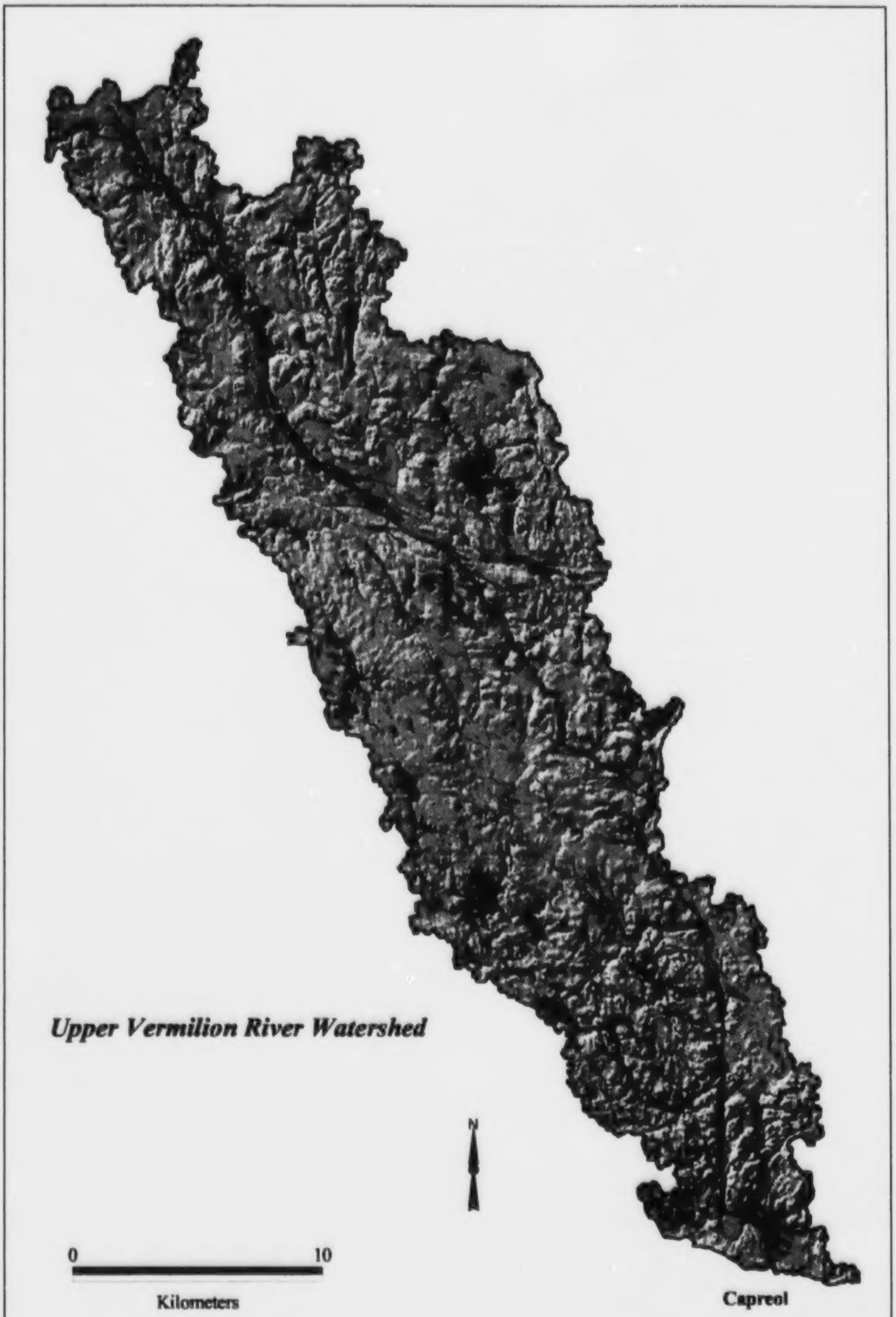

Figure 2. Hydrologically-correct digital elevation model of the Upper Vermilion River watershed.

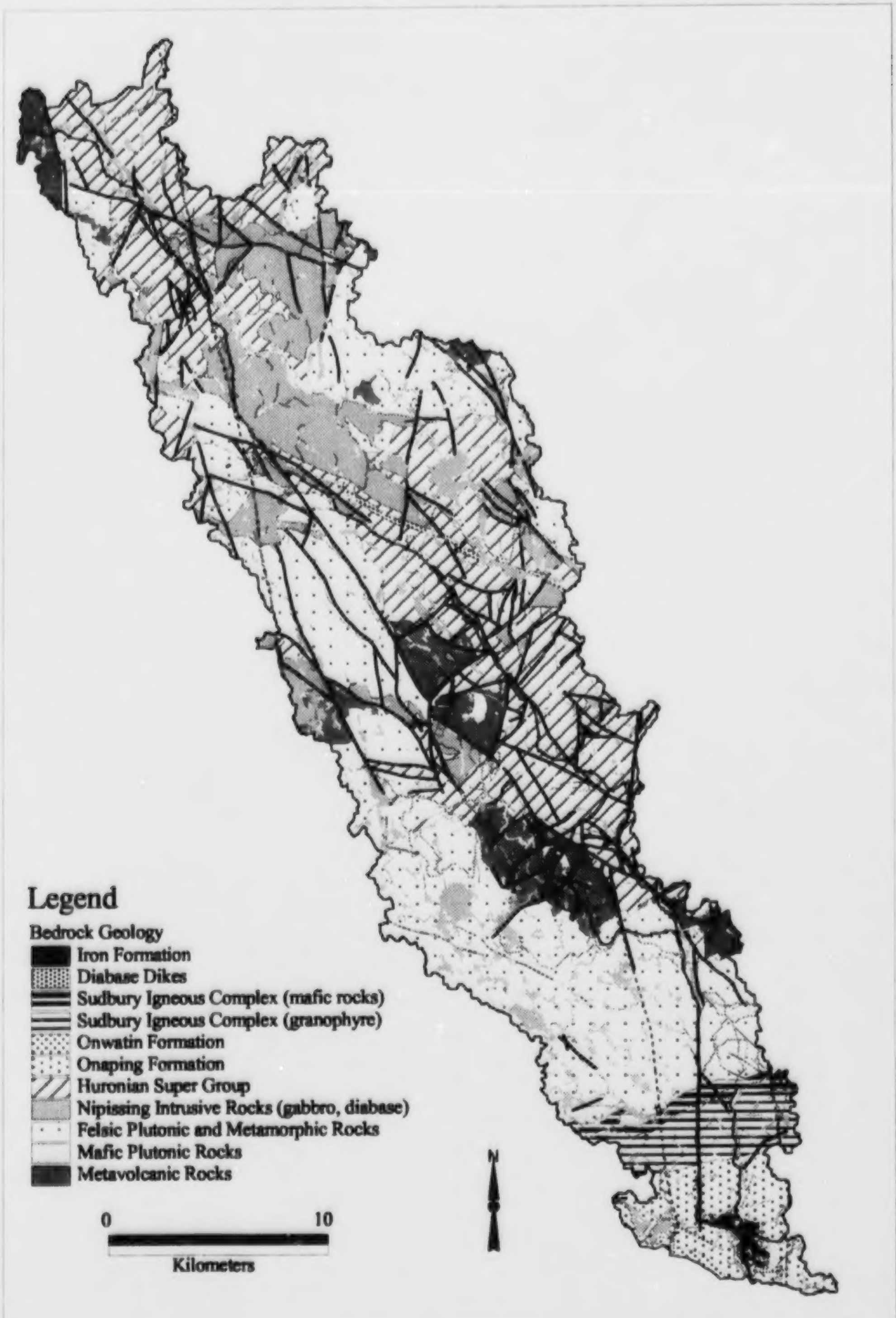

Figure 3. Simplified bedrock geology of the Upper Vermilion River watershed (after Meyn 1970, 1971, 1973, 1976, Dressler 1982).

Glacier ice flow across the area was predominantly southerly. Measured orientation of striations ranged from 175° to 195° and those reported in the literature have a somewhat wider range (150° to 210°) but similar overall trend (Meyn 1970, 1971, 1973, 1976, Dressler 1982). Variations in direction of ice flow are commonly associated with local bedrock surface slopes.

Till (map units 1, 2, 3 and 4, Figure 5; back pocket) is the dominant sediment type in the upland areas. It occurs as a thin, discontinuous cover over the bedrock surface. Locally it can been found to exceed 2 m in thickness, generally on the up-ice (stoss) and down-ice (lee) sides of rock ridges and knolls. The till is a poorly-sorted, stony, silty-sand mixture of mineral and rock fragments (diamicton) that appears massive or fissile. The till matrix varies between 70% and 80% sand and the remainder is predominantly silt-sized particles. Clay content is very low, commonly less than 2%. Mean grainsize is 2.75 phi or the size of fine-grained sand. In lee-side depositional settings, discontinuous interbeds of sand and/or gravel can be common. For the most part the till observed during fieldwork was interpreted as being deposited subglacially as lodgement till or lee-side cavity fills (lodgement, melt-out and flowtills) from debris transported in the base of the glacier. The till, therefore, is likely a good sampling medium for mineral exploration surveys (i.e., locally derived).

The Cartier I Moraine, which marks the southern boundary of the study area, is built primarily of supraglacial flowtills (thinly-bedded diamicton beds of distant-travelled glacial debris). Other deposits that mark former ice margin positions are small, fragmented and difficult to trace over any distance but occur locally. The northern boundary of the area is also defined by a former ice-margin. Here, the ice margin is marked by a head of a valley train; the start of a large ice-supported braided stream system that carried meltwater from the glacier margin along bedrock-controlled valleys southward toward the Sudbury Basin.

Only a few eskers occur within the Upper Vermilion watershed. Most of these are small and discontinuous. Composed primarily of sand and gravel that was deposited within conduits within or under the glacier, these ice-contact stratified deposits can, like till, also reflect the composition of the debris being transported in the glacier, as well as material being eroded beneath the glacier by meltwater flow. Meltwater flowing from the conduits also supplied sediment directly to the extensive braided stream network (outwash deposits) that formed in front of the receding ice margin. Eskers were sampled where they entered the basin and where they exited the basin, in order to determine if gold was being transported into the watershed or exported out.

Thick and extensive glaciofluvial outwash sediment (Map unit 6, Figure 5; back pocket) is the dominant deposit found within the bedrock-controlled valleys of the area. The outwash is the result of an extensive braided river system that developed in the Upper Vermilion River basin as meltwater drained from the northward receding ice margin to glacial Lake Algonquin, which occupied the Sudbury Basin. Outwash deposits can exceed 5 m in thickness and consist of massive to trough cross-bedded gravel, gravelly sand and/or sand. Samples of outwash were collected throughout the Upper Vermilion watershed primarily from the massive, imbricate cobble to boulder gravel facies of these braided stream sediments.

A thin discontinuous veneer of loess occurs throughout the watershed, particularly in upland areas. Recent deposits of peat and muck are forming in wetland areas and along low gradient reaches of the Vermilion River and its tributaries (map unit 7, Figure 5; back pocket). Modern stream sediments are being deposited primarily in riffles, mid-channel bars and in deltas, but were of too limited distribution to show on the accompanying map of the surficial geology (Figure 5; back pocket). Stream sediments were the primary sampling targets of the current project.

The study area is included on the surficial geology map of Boissoneau (1965) and engineering terrain geology maps of Gartner (1980a, 1980b). Prest (1949) and Bajc (1997a, 1997b) have mapped the Quaternary geology of the southern part of the area. Figure 5 (back pocket) is a map of the surficial geology of the Upper Vermilion River watershed, prepared for this project, that combines air photograph interpretation, limited field observations and a simplification of the 1:20 000 scale Quaternary geology maps (Bajc 1997a, 1997b).

Geographical Information System (GIS) Methodology

DEM METHODOLOGY

One of the goals of this project is to evaluate the use of a geographical information system (ArcInfo™ and ArcView™ GIS software packages) to assist in sample site selection to optimize time in the field and reduce field expenses.. This goal was in part achieved through a B.Sc. thesis completed at Laurentian University (Leney 1999, Leney et al. 1999). The first step, that was thought to be key to the overall study objectives, was to create a hydrologically-correct digital elevation model (DEM) for the watershed.

The Upper Vermilion River basin is represented on 22, 1:20 000 scale digital Ontario Basic Mapping (OBM) maps with a contour interval of 10 m. To create the base map, the pertinent coverages (drainage, contours, transportation, spot elevations, and townlines) from each map were joined with adjacent maps. In some coverages, vectors were found to be as much as 1400 m off between adjacent maps. In order to ensure continuity between maps, edge matching was undertaken, checking arcs and their attributes for consistency. Once the adjustments were made, the selected coverages of the 22 maps were joined into 1 base map using the APPEND command.

Once the base map was completed, the drainage coverage arcs were checked for direction and flipped, if necessary, so that the streams flowed down hill. A hydrologically-correct digital elevation model (DEM) with a nominal spatial resolution of 30 m was generated (Figure 2).

The TOPOGRID algorithm used for DEM construction incorporates information from the drainage, contour and spot elevation coverages. It is based on the ANUDEM procedure developed by Hutchinson (1989) that takes into account the contribution of streams to the overall form of the land surface. As a result, TOPOGRID imposes constraints on the interpolation process and results in a better representation of the ridges and streams within the landscape.

Watershed basin analysis was performed on the hydrologically-correct DEM using various GRID™ programs within ArcInfo (FLOWDIRECTION, BASIN, STREAMORDER, FLOWACCUMULATION, NETWORK, SLOPE). The overall watershed of the Upper Vermilion River was delineated and over 80 sub-watershed basins were identified. Stream ordering, following Strahler (1952, 1953) and Shreve (1967) methods, was undertaken and the gradient of the streams within the watershed determined. Each of these watershed parameters (watershed basin, sub-watershed basins, stream order and stream gradient) was evaluated during the sample site selection process.

The DEM helped in both the analysis and in the visual representation of the watershed. In addition, polygon and point data from bedrock and Quaternary geology maps, as well as mineral occurrences, were incorporated as coverages into the GIS to aid in data interpretation and presentation.

SAMPLING SITE SELECTION PROCESS

Various queries were run to determine locations for sampling to optimize time in the field and reduce field-related expenses. Before querying the hydrologic model, several watershed variables and their effects on the transport and deposition of heavy minerals, in particular gold, on a regional or system scale and a local scale had to be considered.

It was decided that samples should be collected from each of the identified sub-watershed basins in order to obtain a good spatial distribution of samples that would reflect the heavy mineral signature of the entire watershed. However, it was decided to decrease this total number of sub-basins by combining several of the smaller sub-basins (less than 0.5 km^2) with larger ones by a query in ArcEdit that reduced the total number of sub-basins to 67 (Figure 6). Project limitations as to the total number of samples to be collected and analyzed, however, would only allow the collection of 1 sample per sub-watershed basin. Consequently, once the sub-watershed basins were determined using the GIS, the next step of sample site

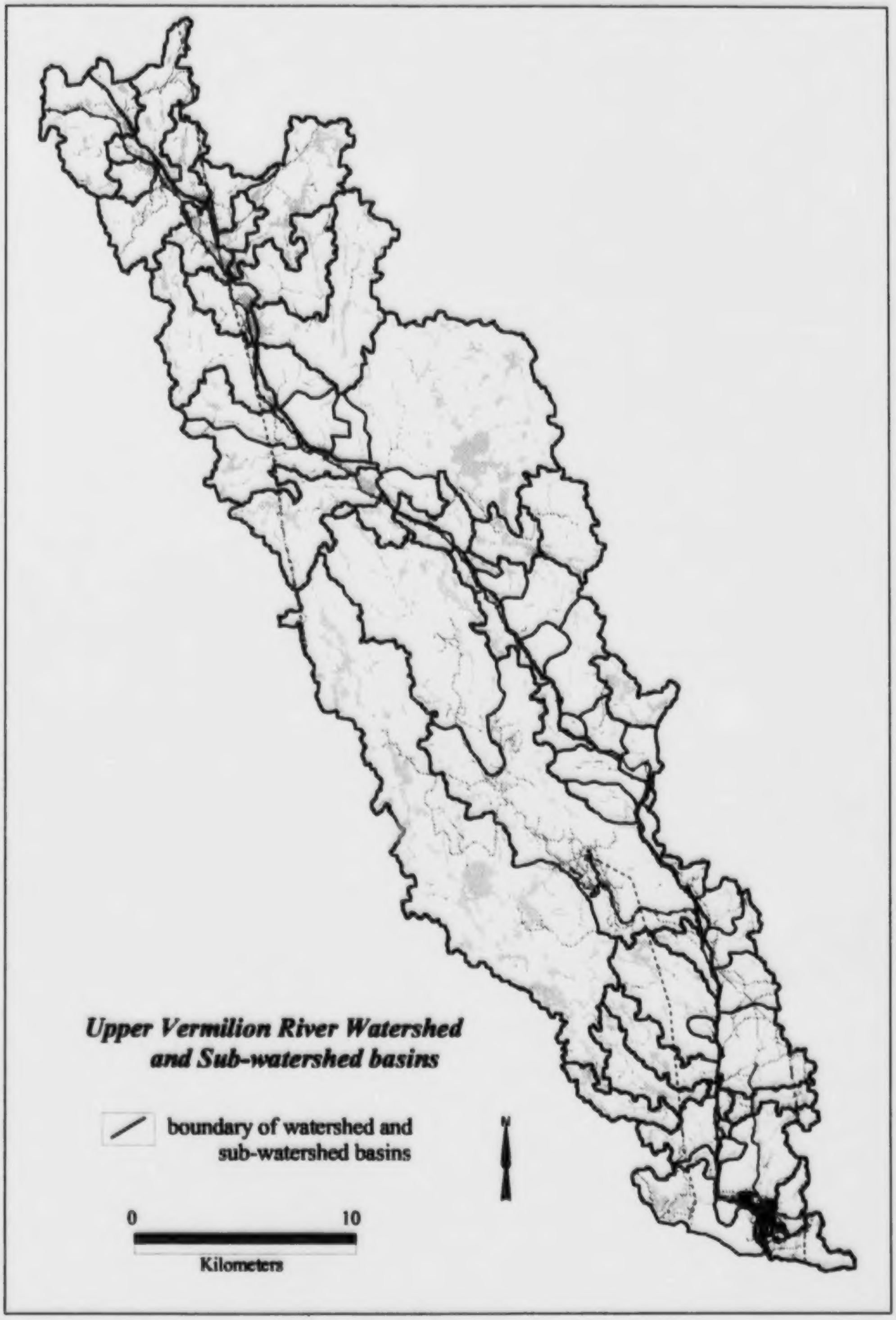

Figure 6. Upper Vermilion River watershed and sub–watershed basins.

selection was to determine where in each sub-watershed basin to sample. The characteristics of the stream network within each sub-basin became very important to the site selection process.

In a typical river drainage network without lakes or swamps, it would be ideal to sample where the highest order stream exits the sub-watershed basin. Stream ordering could be done using either the Stralher or Shreve methods, however, the Shreve method, which reflects the discharge of the various stream segments, may be the more applicable method to use in a stream sediment sampling survey.

The problem with using this approach in streams, like the Upper Vermilion River and many other streams within the Precambrian Shield, is the effect that numerous lakes and swamps located along their lengths have on stream ordering. When a stream enters a standing body of water, such as a lake or swamp, flow expansion occurs and stream competence decreases resulting in the deposition of all but the finest textured sediments that were being transported. Consequently, as far as sediment transport is concerned, the continuity of the stream is broken. The usefulness of stream ordering methods for stream sediment sample site selection also comes into question.

Due to the large number of lakes within the Upper Vermilion watershed, it was decided that stream length was the best variable to use in determining optimum sample locations. In general, it was concluded that the greater the length of stream, the greater area for stream erosion and contribution to stream sediment load. Also, the greater portion of the sub-watershed basin would be represented. Stream length was derived by calculating the sum of the lengths of all converging streams that were not separated by standing bodies of water. Once the aggregated stream lengths were determined and the greatest length selected for each sub-basin, a label representing the proposed sample site was placed at the point where the streams entered the standing body of water (Figure 7). By selecting these locations for sampling the selected sites represented both the maximum aggregated length of stream within the sub-basin as well as the site of sediment deposition as streams enter standing bodies of water.

Important factors considered in the site selection model at a regional or system scale included sub-basin representation and length of stream above a lake or swamp. Important factors considered at a local scale included; stream gradient and the locations of riffles/rapids, deltas and bars (obtained from air photographs, OBM maps and/or Landsat TM).

RESULTS

A total of 68 stream sediment sampling sites were predicted by the GIS queries (Figure 8). Approximately 40% of the predicted sample sites were visited in the field and sample collection attempted. Of these sites visited in the field, about 80%, or 4 out of 5, were valid and sampled. Sampling of about 60% of the predicted sites was not attempted due to access problems and/or time constraints. However, alternative sites were collected for about 40% of these sites using the next best site in the sub-watershed basin following similar selection procedures (Figure 8).

Field Sampling and Laboratory Processing

Sediment sampling took place during the summer of 1998. In total, 102 samples were collected (Appendix A) and processed for their heavy mineral content. Of the 102 samples, 54 were of modern stream sediments. Samples were taken from several depositional environments within the streams. In the smaller tributaries, samples were collected commonly in the lee of large boulders, from longitudinal and point bars and from the base of channels or chutes. In broader areas of the Vermilion River, samples were taken from riffles and longitudinal and transverse bars. Where the tributaries entered lakes of the Vermilion River system, delta topsets, foresets and distributary channel sites were sampled.

To help in the interpretation of the results of the stream sediment samples it was decided to characterize and sample the glacial sediments that occur within the drainage basin. Till reflects the character of the debris being transported by ice into and within the basin. The properties of sediments being deposited

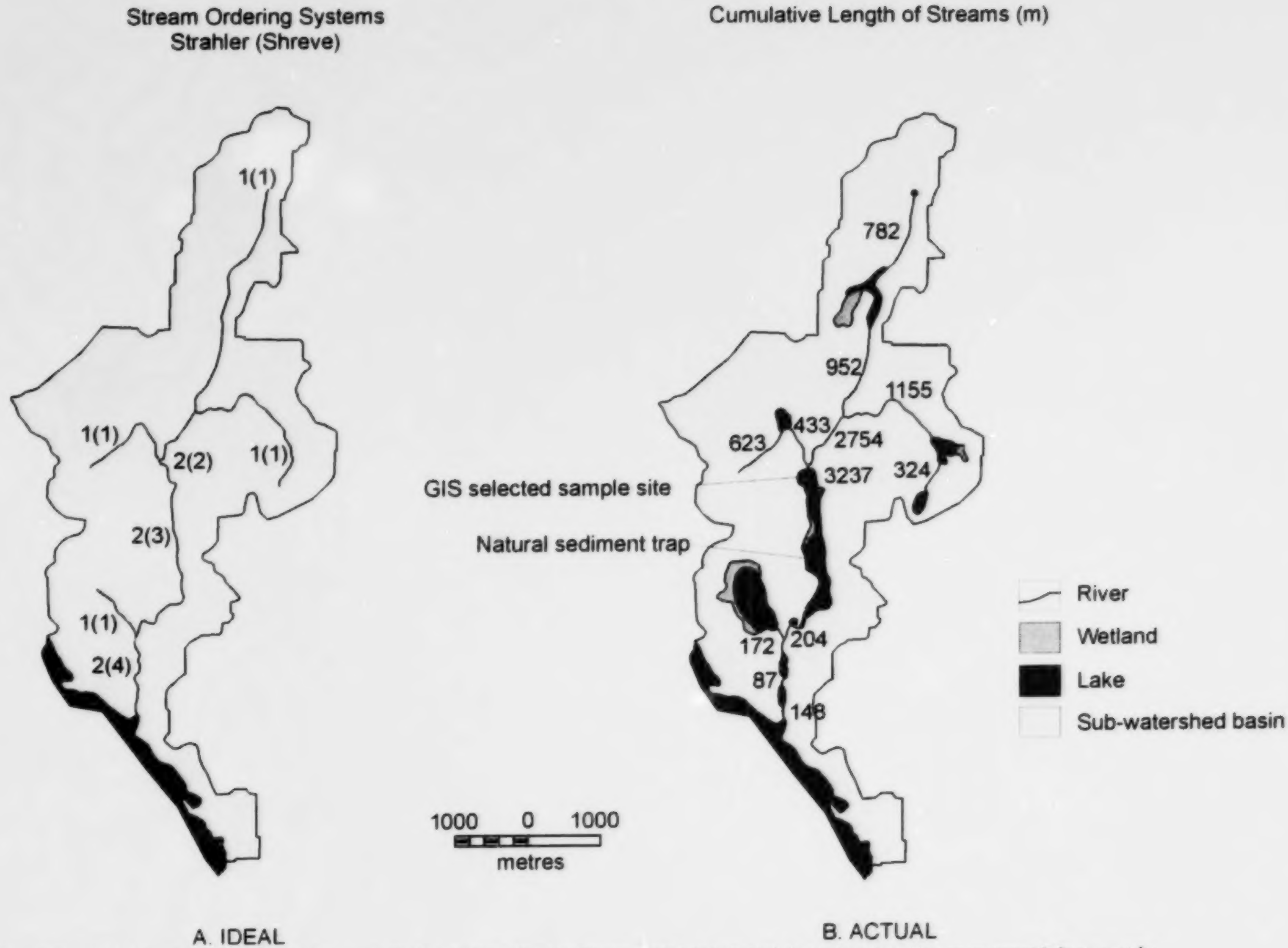

Figure 7. Comparison of an "ideal" and "actual" sub-watershed basin of the Upper Vermilion River watershed. In A, the ideal, the numbers along side a stream segment is the stream order according to the method of Strahler (1952) and Shreve (1967), in brackets. In B the numbers along the stream segments are the cumulative length of uninterrupted stream (m).

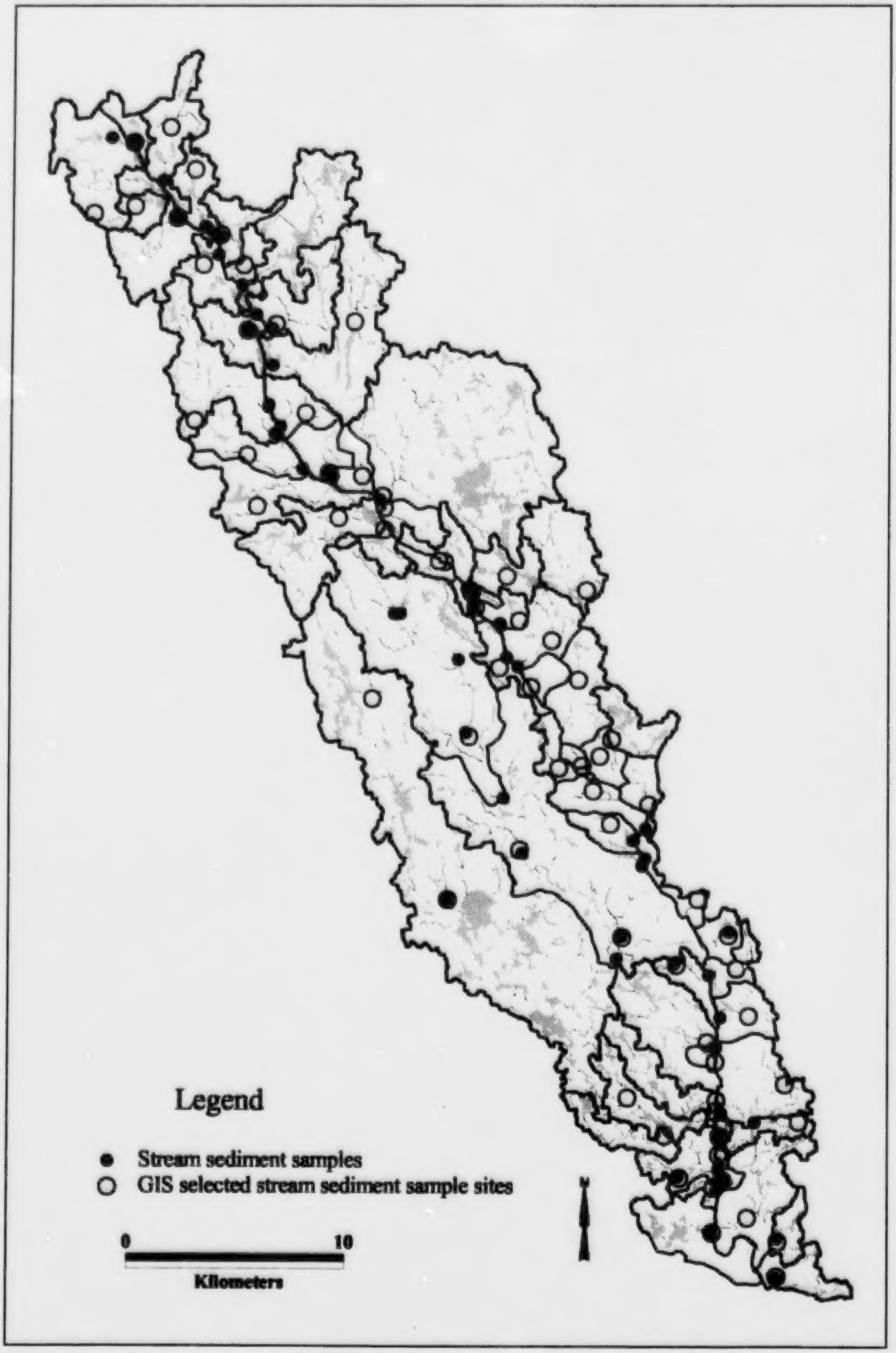

Figure 8. Comparison of GIS selected stream sediment sampling sites and actual sample sites.

within glacial meltwater conduit systems can be determined from sampling eskers. The major tracts of outwash sediment are the product of glacial-fed braided streams and provide possible targets for placer gold exploration.

Thirty-three samples were taken from exposures of outwash sediment along the length of the watershed. Samples were collected predominantly from massive, imbricate boulder gravels, a facies that proved to be very common in the project area. Samples were also taken from trough cross-bedded gravel and sand facies. Several samples were taken at 3 selected sites to determine the in-site variation in heavy mineral content. In addition, 8 samples were taken from the boulder gravel facies of eskers and 7 till samples were collected.

All samples were sieved in the field and the minus 7 mm portion was sent for heavy mineral processing to Overburden Drilling Management, Nepean, Ontario. All samples were processed for gold and 19 selected samples were processed for kimberlite and metamorphic/magmatic massive sulphide indicator minerals (KIMs and MMSIMs®) following procedures developed by Overburden Drilling Management (Averill and McClenaghan 1994). The samples that weighed between 10 and 15 kg were passed over a shaker table to concentrate the heavy minerals. While on the shaker table a preliminary gold grain count and estimate of gold grain size and shape was made. Samples that were observed to contain more than 4 grains of gold on the table were subsequently panned and the total number of gold grains, their size and shape recorded. The gold grains were then returned to the table heavy mineral concentrate. The table heavy mineral concentrate was then subjected to a heavy liquid separation (specific gravity 3.2). Kimberlite and metamorphic/magmatic massive sulphide indicator minerals were then picked from the heavy liquid mineral concentrate and counted. KIM grains were then mounted and probed to determine their chemistry. In addition, samples from till, outwash and esker sample sites were taken for grain size analysis and for pebble lithology studies.

Results

GOLD

Sampling stream sediments for mineral indicator grains was one of the prime goals of this project. Extensive glaciofluvial outwash deposits that occur within most of the bedrock-controlled valleys in the area were also sampled for their gold content. A few samples of the till in the area and ice-contact stratified sediments from eskers were also sampled.

Gold grains are commonly silt-sized and generally mirror the grain size of the parent bedrock mineralization (Averill 1999). Gold grain shape can be used as an indication of transport distance, since gold is soft and malleable. Three classes of gold grain shapes are recognized: pristine, modified and reshaped (DiLabio 1990). Averill (1999, p.119) suggests that in till samples, the "reshaping process is typically complete after 1 km of transport but may require 5 km ...". Whether these distances for the reshaping process hold true for gold grains in glaciofluvial and fluvial (stream sediments) systems is to date uncertain. The results presented below highlight samples containing relatively high numbers of gold grains (mean plus 2 standard deviations) and that contain pristine and modified gold grain shapes.

Till

Till is the product of the direct deposition of debris that was carried within the glacier and reflects bedrock geology that occurs in an up-ice flow direction from the sample site. Till in the area is generally thin and discontinuous. It is commonly massive, poorly-sorted and stony; with a silty-sand to sand matrix (Barnett and Bajc, in press).

Till outcrops in the upland areas above the outwash plains. Only a few samples of till were collected during this study, however, gold grain results of 23 samples of till collected by A.F. Bajc during the

summers of 1992, 1993, 1994 from within the Vermilion River watershed (Bajc and Hall, in prep.) are included here. The distribution of gold in till samples is displayed in Figure 9 and summarized in Appendix B. Gold grain content in surface till samples from adjacent Parkin and Norman townships has been investigated by Bajc (1994).

The total numbers of gold grains in till samples are generally low with a mean between 4 and 5 grains and a range of counts between 0 to 42. Most samples provide information on the background levels to expect within the Upper Vermilion River watershed.

Samples of till and flowtill taken from the Cartier and several smaller moraines are included in Appendix B but are not discussed in any detail here (*see* Bajc and Hall, in prep.). In general, taking samples from moraines should be avoided since the interpretation and tracing of any anomalous values back to their source can be very difficult because of the possibility for long distance and complex transport paths. In fact, some of the highest concentrations of gold in till were from samples taken from the Cartier Moraine near Capreol (92-AFB-4159, 92-AFB-4162).

A sample of subglacial till of possible interest is sample 92-AFB-4155, which contains only 3 gold grains, however, 1 grain is pristine and another is 550μ by 750μ in size (Figure 10). Finding pristine gold grains is of interest because the transport distance of the mineral could be small and the sample may be close to the source. Other samples (Appendix B) that contain pristine gold grains are 92-AFB-4064 (3 pristine and 6 total grains), 92-AFB-4066 (1 and 7), 98-PJB-032 (1 and 4), 98-AFB-4059 (1 and 2) and 92-AFB-4165 (1 and 1).

Glaciofluvial ice-contact stratified sediment

Only a few eskers occur in the Upper Vermilion River watershed. They tend to be sinuous, discontinuous, short in length and less than 15 m in height. Longer and larger eskers occur adjacent to the watershed and the larger ones were sampled during this study. The distribution of gold in esker samples is displayed in Figure 9 and summarized in Appendix B. Gold content was low, between 0 and 3 grains per sample, in the 8 samples collected. And all but 1 of these grains was reshaped (Figure 10, Appendix B).

Glaciofluvial outwash sediments

Glaciofluvial outwash sediments are the dominant Quaternary deposit type along the valleys of the watershed (map unit 6, Figure 5, back pocket). Thirty-three outwash samples were collected within the study area (Figure 11). The mean gold grain content was 3 to 4 grains with a standard deviation of about 7. The distribution of gold in outwash samples is displayed in Figure 12 and a summary of individual sample results is given in Appendix B.

Anomalous gold grain counts were obtained in samples 98-PJB-35-1-1 and 98-PJB-51-1-1 and a high number of grains were counted in sample 98-PJB-55-1-1. Gold grains in all these samples were reshaped. Pristine grains (Figure 13) were obtained from samples 98-PJB-31-1-1 (2 pristine of 4 total grains), 98-PJB-11-1-1 (1 of 5) and 98-PJB-55-1-1 (1 of 4). The ratio of pristine and modified grains to the total gold grains in a sample was equal to or exceeded 0.2 or 20% in 6 samples. Samples with pristine and modified grains included 98-PJB-2-1-1 (0.5 ratio, 2 total grains), 98-PJB-31-1-1 (0.5, 4), 98-PJB-11-1-1 (0.4, 5), 98-PJB-47-1-1 (0.3, 4), 98-PJB-49-2-1 (0.3, 4) and 98-PJB-70-1-1 (0.2, 9).

Multiple samples were taken at 3 selected locations to get an idea of the variability of gold grain counts at one location and within various sedimentary facies. The results are given in Table 1.

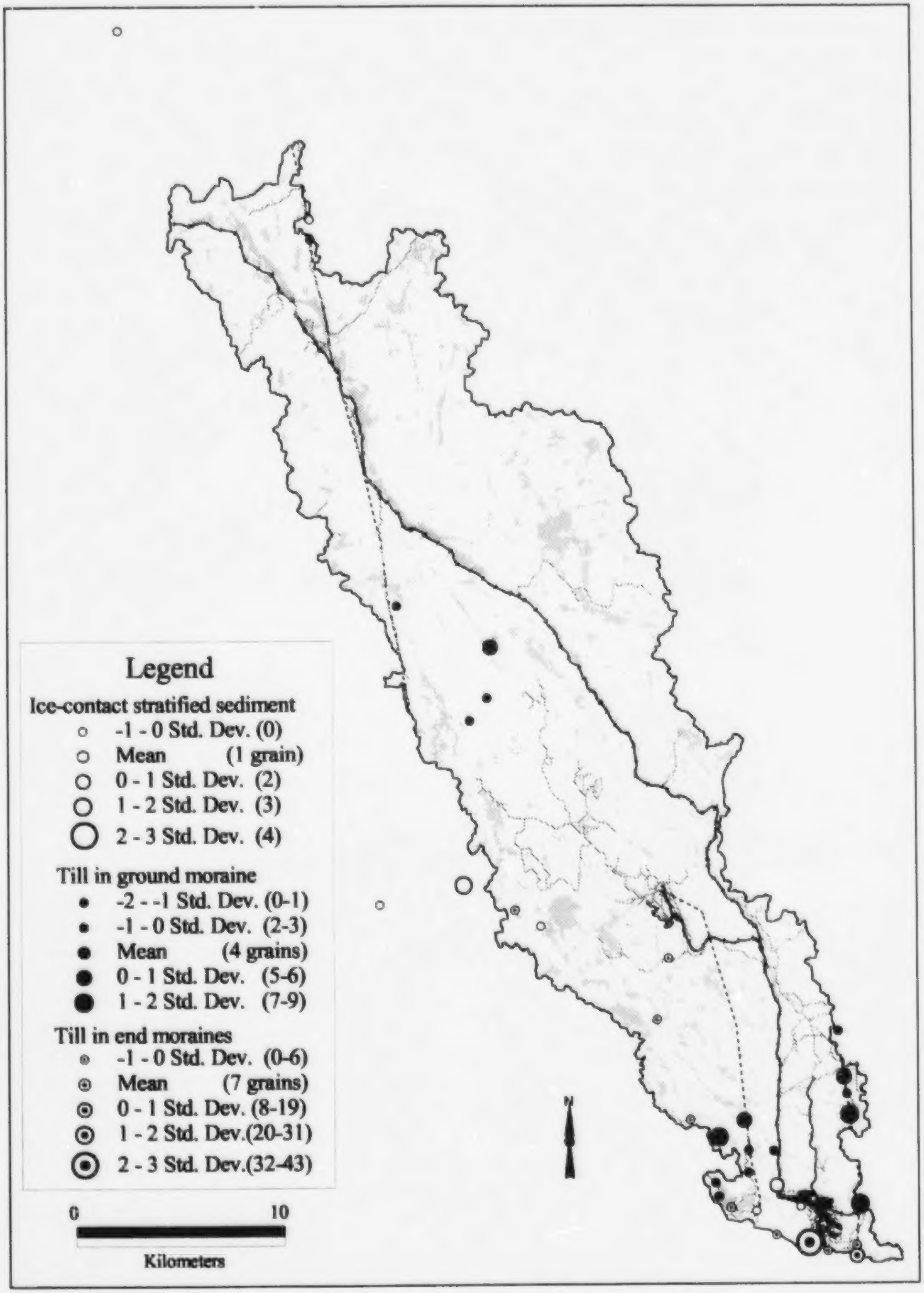

Figure 9. Distribution of gold grains in ice-contact stratified sediment, till in ground moraine and till in end moraine samples.

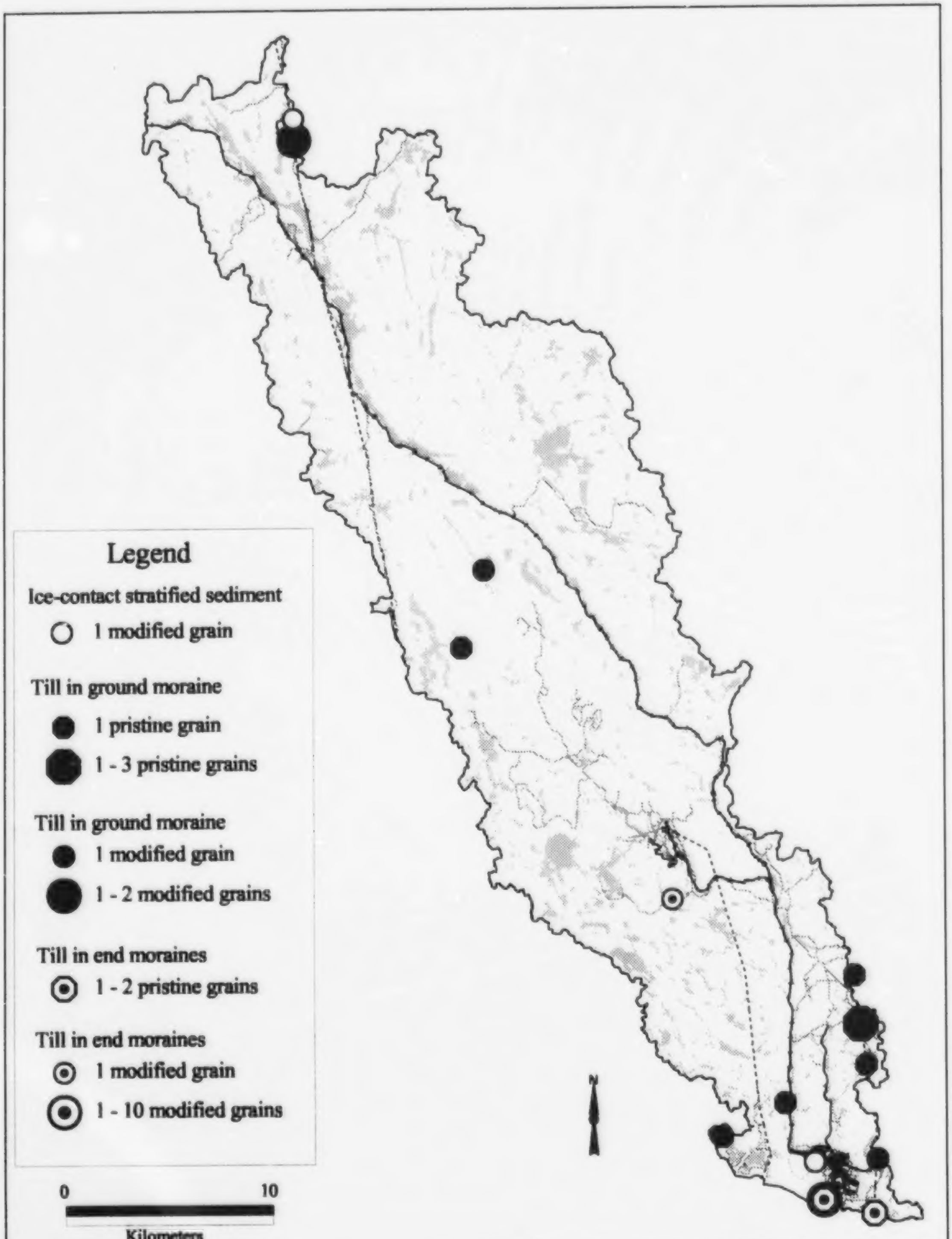

Figure 10. Distribution of pristine and modified gold grains in ice-contact stratified sediment, till in ground moraine and till in end moraine samples.

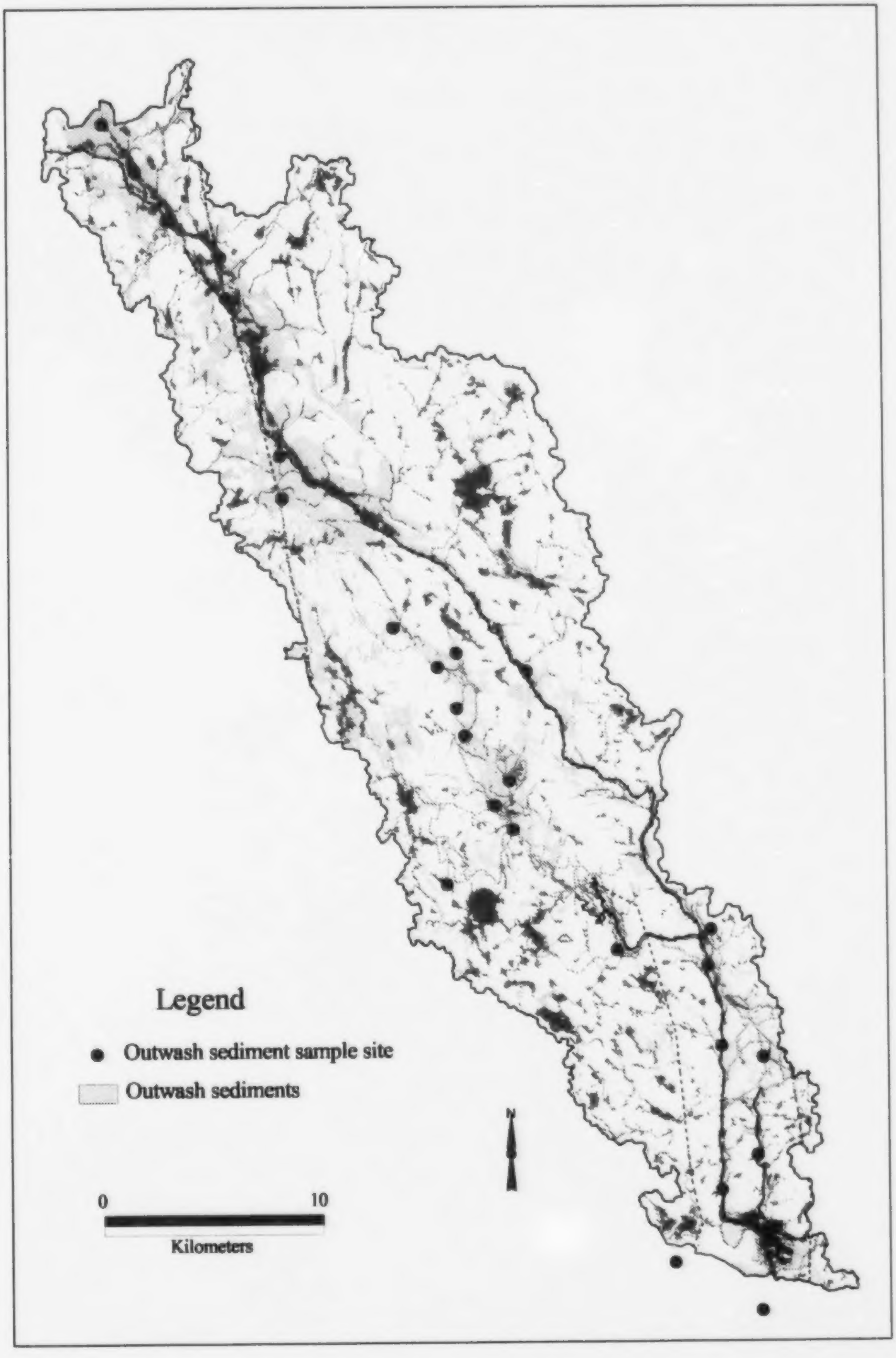

Figure 11. Distribution of outwash sediments and outwash sediment sample sites.

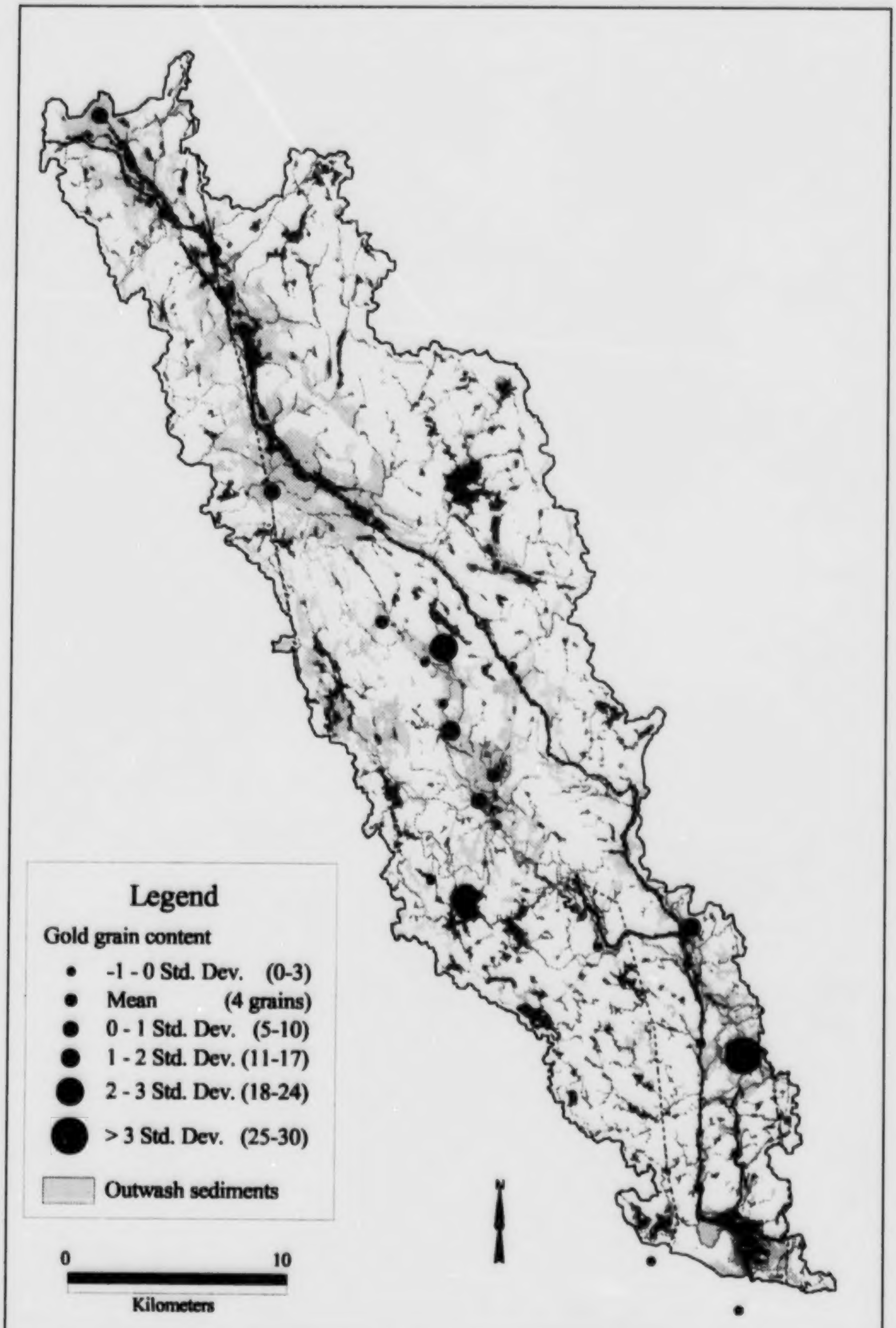

Figure 12. Gold grain content of outwash sediments.

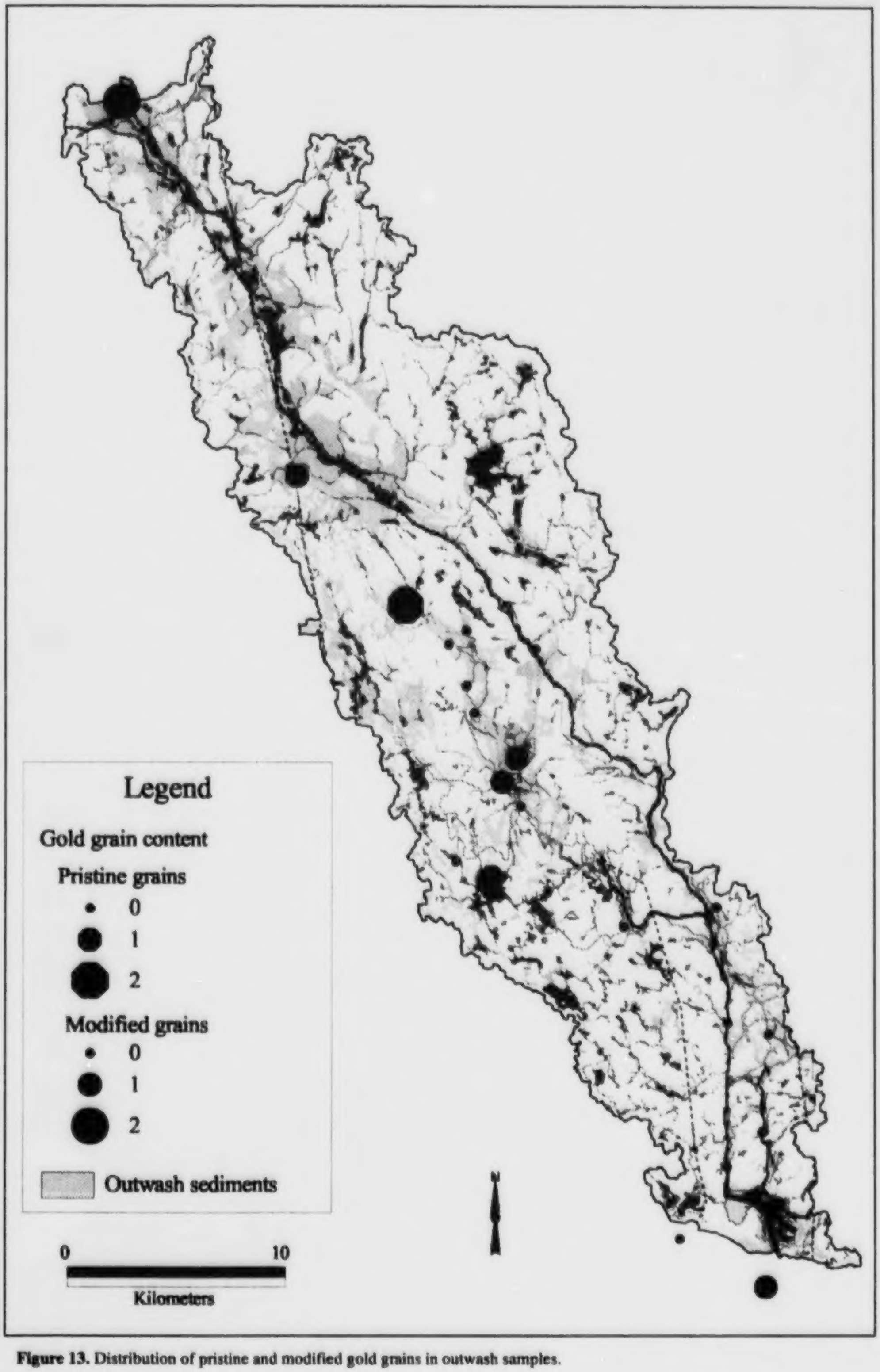

Figure 13. Distribution of pristine and modified gold grains in outwash samples.

Table 1: Variability of gold grain counts at a station.

Site	Sample Number	Sediment Facies	No. of gold grains
1	98-PJB-2-1	Massive, imbricate cobble and boulder gravel	2
1	98-PJB-2-2	Trough cross-stratified medium- to coarse-sand	0
1	98-PJB-2-3	Plane-bedded fine- to medium-sand, heavy mineral laminations	2
2	98-PJB-48-1	Trough cross-stratified, fine- to coarse-sand*	0
2	98-PJB-48-2	Plane-bedded to trough cross-bedded pebble gravel +	6
3	98-PJB-49-1	Trough cross-stratified, fine- to coarse-sand*	1
3	98-PJB-49-2	Trough cross-bedded small pebble gravel +	4

* Units are laterally equivalent and traceable.

\+ Units are laterally equivalent and traceable

Table 2: Summary of heavy mineral results from the various depositional environments sampled.

Gold Grains in:	χ	σ	n	Min	Max
Longitudinal bars	1.6	2.5	12	0	7
Point bars	0.8	1.3	15	0	4
Riffles	0.7	0.8	6	0	2
Transverse bars	0.2	0.44	5	0	1
River channels	1.7	1.0	6	0	3
Deltas	2	1.7	7	0	4
Beaches	0	0	3	0	0
% Heavy Minerals in:	χ	σ	n	Min	Max
Longitudinal bars	6.6	3.8	12	1.5	14.2
Point bars	10.9	7.6	15	2.4	34
Riffles	11.1	5.5	6	4.2	18.5
Transverse bars	5.6	3.4	5	3.5	11.6
River channels	18.2	15.1	6	2.4	40.9
Deltas	16.7	7.5	7	3.8	24
Beaches	17.4	16.7	3	3.1	35.8

Where: χ, is the mean,
σ, is the standard deviation,
n, is the total number of samples analyzed,
Min, is the minimum value,
and Max, is the maximum value obtained.

Stream sediment samples

Fifty-four stream sediment samples were collected during the field component of the project (Figure 8). Seven depositional environments were sampled to obtain representation from each defined sub-watershed. A summary of the gold grain and heavy mineral content of each of the 7 depositional environments sampled is given in Table 2. The distribution of gold in stream sediment samples is displayed in Figure 14 and individual samples summarized in Appendices A and B. Figure 15 displays the location and amount of pristine and modified gold grains that were identified in the heavy mineral separates.

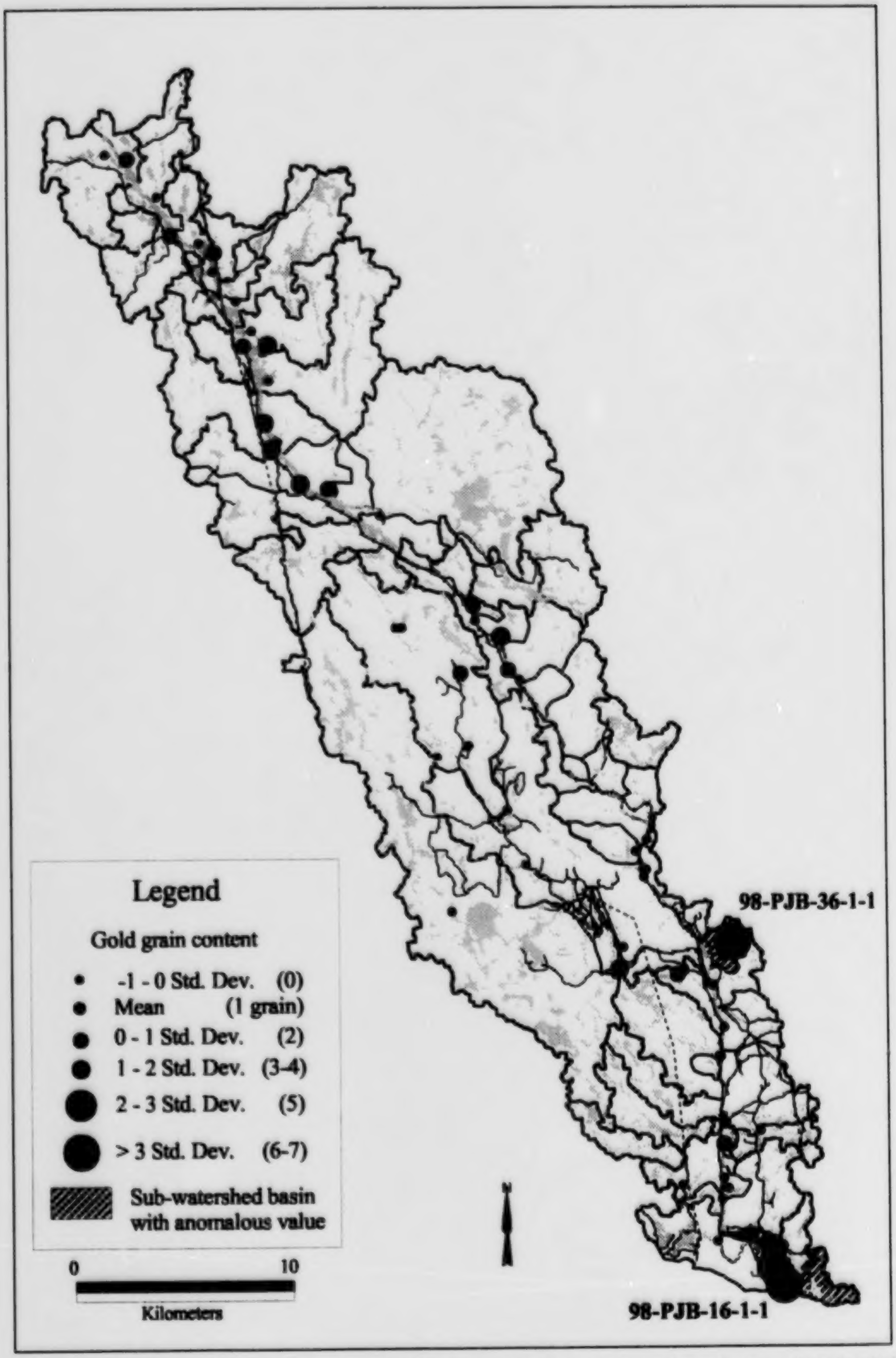

Figure 14. Gold grain content of stream sediment samples. Sub-watershed basins in which anomalous values were obtained are highlighted.

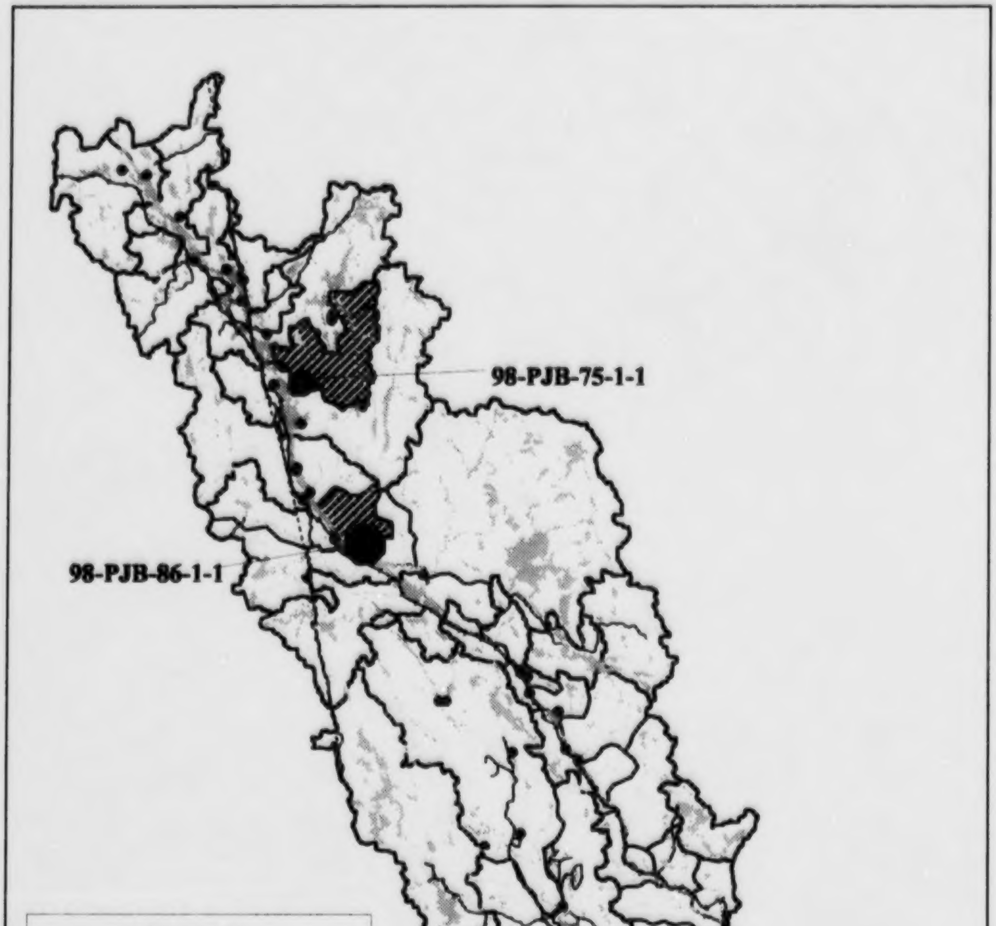

Figure 15. Distribution of pristine and modified gold grains in stream sediment samples. Sub-watershed basins in which anomalous values were obtained are highlighted.

The heavy mineral content within each depositional environment varied greatly. Samples from the base of channels, beach deposits and deltas had higher mean concentrations than bar and riffle sites. The range of values, however, was great with samples from each environment having low concentrations of heavy minerals. The sample site depositional environment apparently had little effect on gold grain content.

Two stream sediment samples exceeded background values (greater than mean plus 2 standard deviations). Sample 98-PJB-16-1-1 contained 6 gold grains of which 30% were modified grains. Sample 98-PJB-36-1-1 contained 7 grains of reshaped gold. Of possible interest is sample 98-PJB-86-1-1 in which 1 pristine gold grain was identified (2 total grains) and samples 98-PJB-22-1-1 (1.0, ratio; 2, total grains) and 98-PJB-16-1-1 (0.3, 6) which had ratios of pristine and modified gold grains to total gold grains of greater than 0.2.

KIMBERLITE INDICATOR MINERALS

Associated with diamond-bearing kimberlites is a suite of heavy minerals known as kimberlite indicator minerals (KIMs) (Morris and Kaszycki 1997). These minerals are chemically stable in young glacial sediments and are reported to be concentrated, typically tenfold, in esker sediments relative to tills (Averill 1999). In order to obtain background information for the Upper Vermilion River watershed, 19 samples were processed for KIMs. These included 7 stream sediment samples, 4 till samples, 3 outwash samples and 5 samples of ice-contact stratified sediments from eskers. The results of these analyses are presented below and in Appendix D.

Certain garnets (specifically calcium-poor, harzburgitic "G-10" chrome-pyrope and sodium-rich pyrope-almandine garnets), ultra chromium-rich chromites, ultra magnesium-rich ilmenites and chrome diopsides are indicator minerals for diamond-bearing kimberlite (Averill and McClenaghan 1994, Morris and Kaszycki 1997, Averill 1999). Differentiation of KIMs from non-kimberlite indicator minerals of the same group is done primarily by geochemistry. The KIM data from this project is graphically presented in 2 forms. Figure 16 presents the results as received directly from Overburden Drilling Management and Figure 17 illustrates the result of microprobe work on selected or picked grains from the samples. Specific chemical cross plots that aids in the differentiation of KIMs are also presented (Figures 18, 19, 20 and 21).

The geochemistry of selected garnet grains resulted in the identification of 4 "G-9" chrome-pyrope garnets (Figure 18). Three of these were from one sample, 98-PJB-50-1-1, and the fourth was from sample 98-PJB-14-1-1. The remaining garnets that were probed were 9 spessartine-almandine, 5 almandine and 4 possible andralite-uvarolite solid solution garnets (Appendix F).

None of the ilmenite grains that were probed had greater than 4 wt % MgO (Figure 19, Appendix F). Seven of the chrome diopside grains had Cr_2O_3 concentrations greater than 1 wt %. The seven grains came from 7 different sites: 98-PJB-2-3-1, 98-PJB-7-3-1, 98-PJB-23-1-1, 98-PJB-30-1-1, 98-PJB-50-1-1, 98-PJB-62-1-1 and 98-PJB-85-1-1.

Of the chromite grains examined (Figures 20 and 21), 4 grains plot within the field unique to lamproites and kimberlites (defined by Fipke et al. 1995) based on the cross plot of weight percent (wt %) Cr_2O_3 concentration versus wt % TiO_2 concentration (Figure 20). The 4 grains came from 4 different samples: 98-PJB-23-1-1, 98-PJB-32-1-1, 98-PJB-40-1-1 and 98-PJB-50-1-1. All other grains plotted in the overlap field (Fipke et al. 1995) on this cross plot.

METAMORPHOSED/MAGMATIC MASSIVE SULPHIDE INDICATOR MINERALS (MMSIM®)

Another heavy mineral suite of interest is related to metamorphosed/magmatic massive sulphide deposits (MMSIM®, Averill 1999). This suite includes such heavy minerals as spessartine, red epidote, sapphirine, chromite that does not plot within the field unique to lamproites and kimberlites (Figure 20),

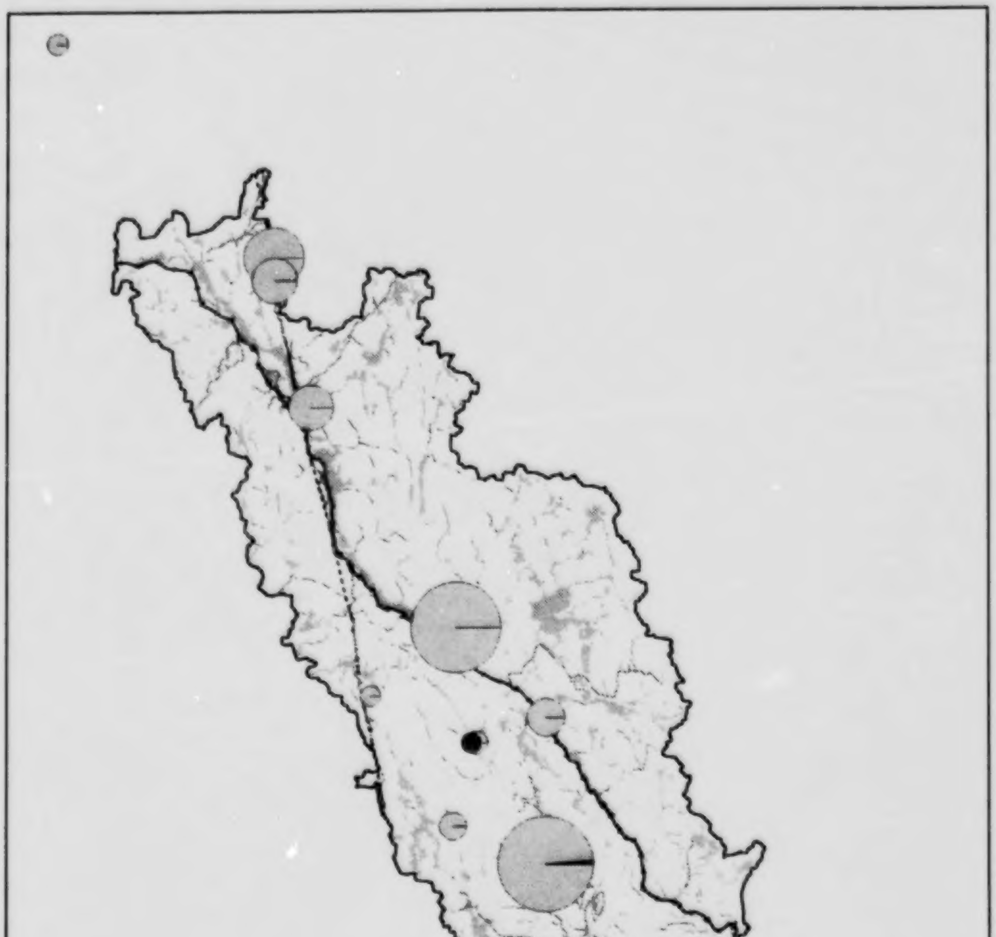

Figure 16. Kimberlite indicator minerals in selected samples determined by Overburden Drilling Management.

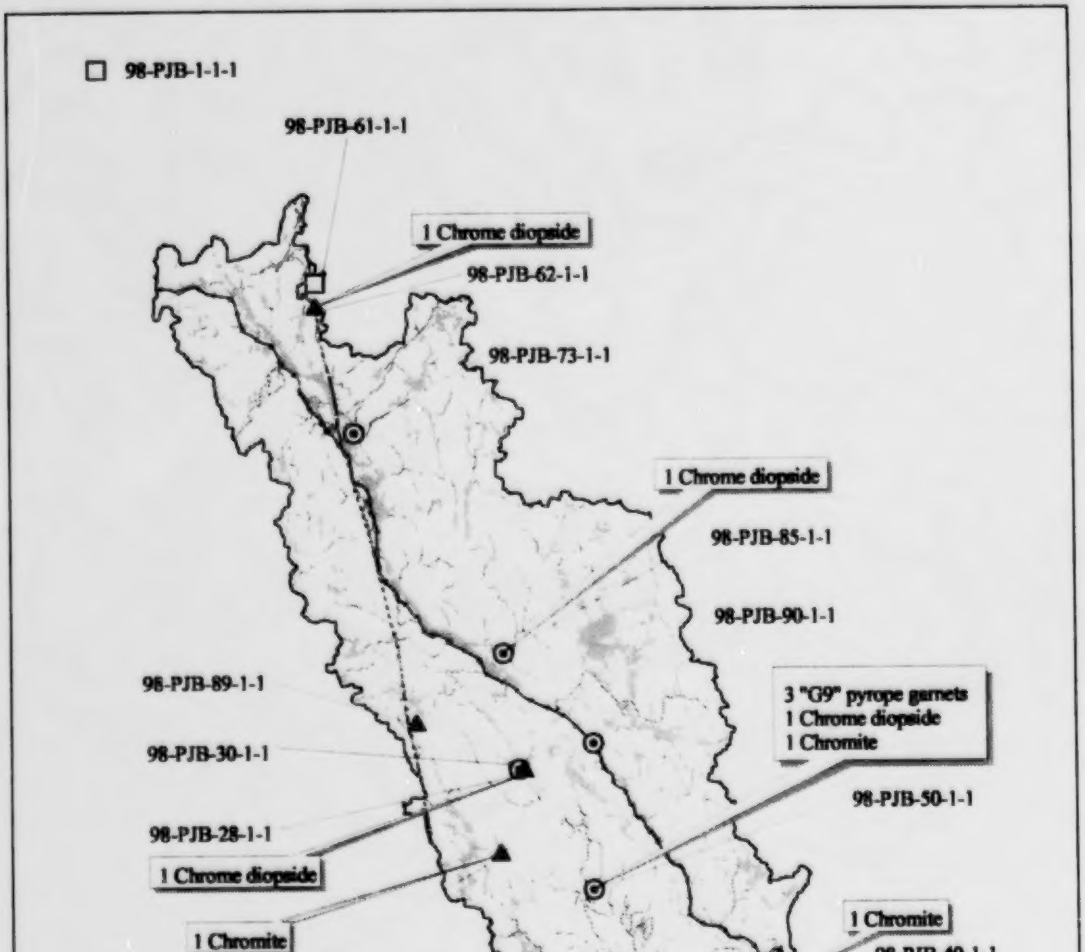

Figure 17. Results of microprobe work on selected heavy mineral grains by the Geoscience Laboratories, MNDM.

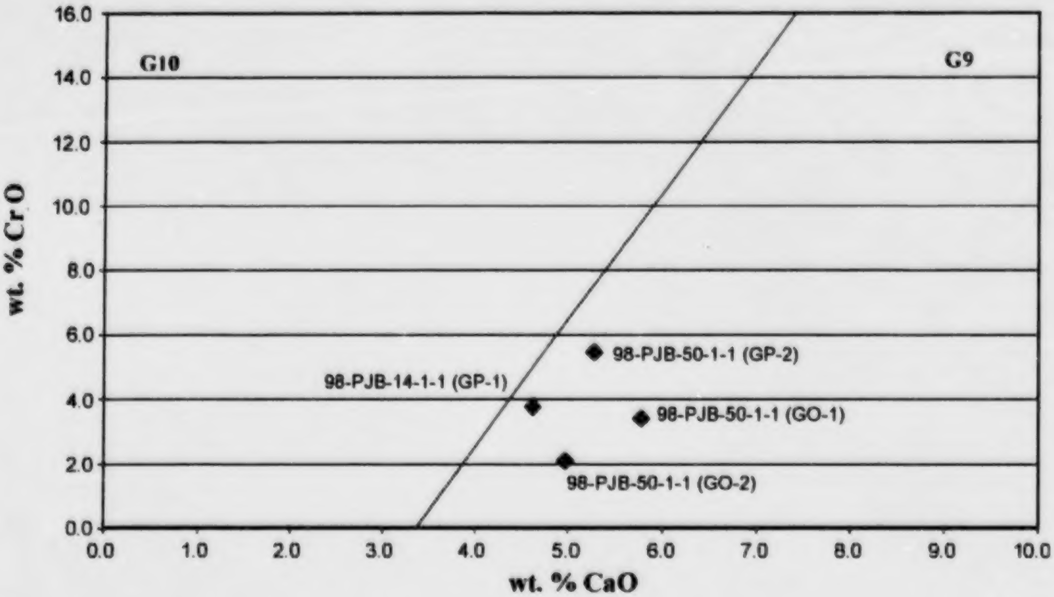

Figure 18. Cr-pyrope garnet Cr_2O_3 – CaO plot (diagram after Dawson and Stephens 1975).

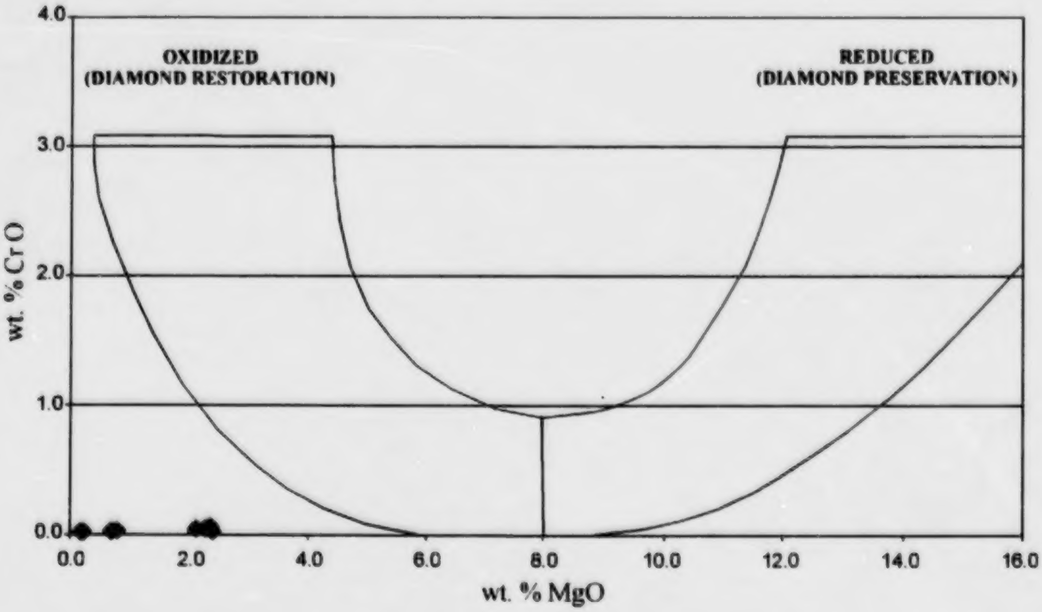

Figure 19. Mg-ilmenite Cr_2O_3 – MgO plot (diagram after Gurney and Moore 1991).

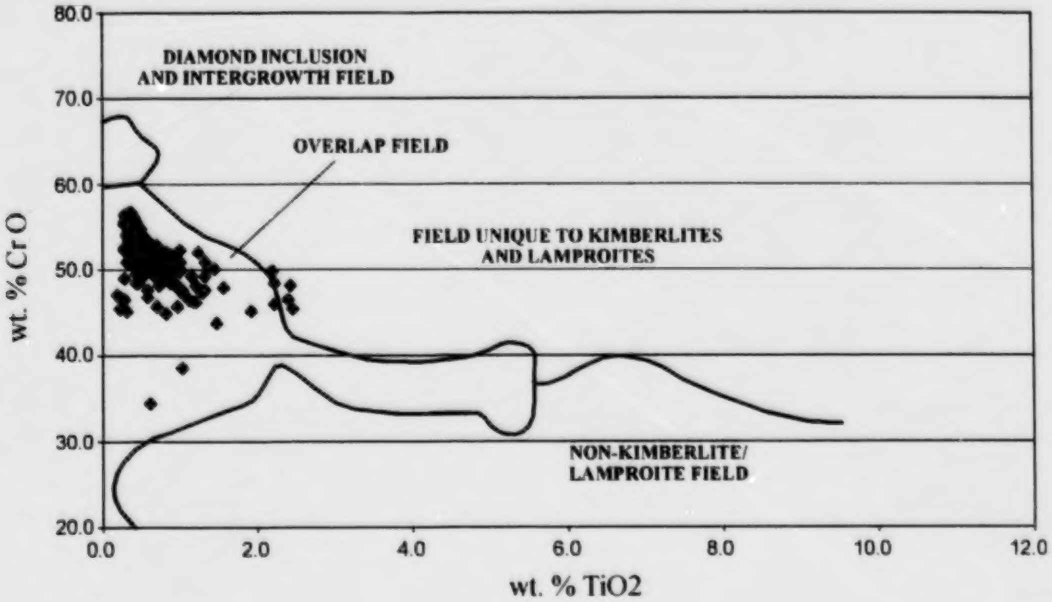

Figure 20. Chromite Cr_2O_3 – TiO_2 plot (diagram after Fipke *et al.* 1975).

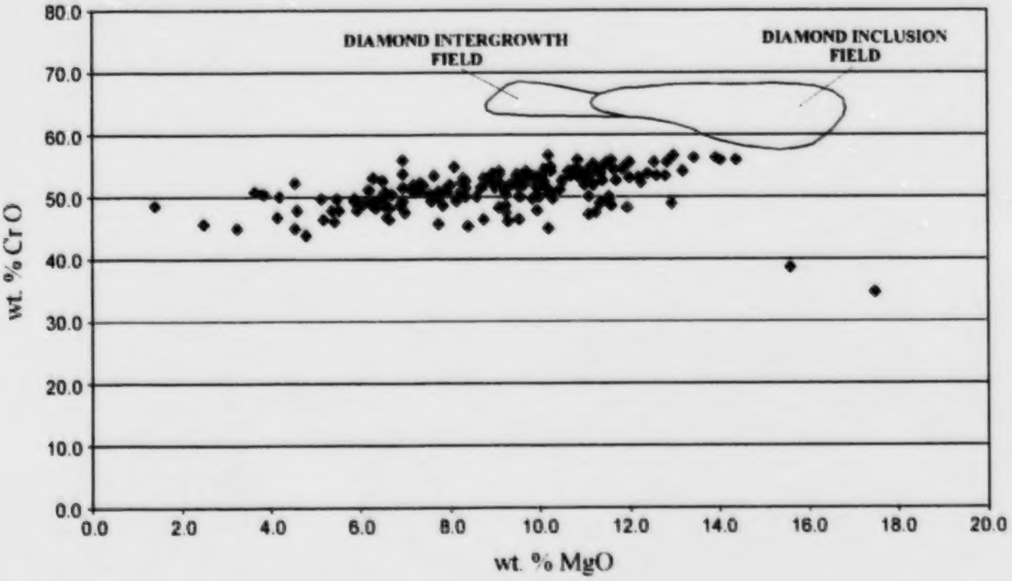

Figure 21. Chromite Cr_2O_3 – MgO plot (diagram after Fipke *et al.* 1975).

red rutile, ruby corundum, gahnite, chrome diopside, chalcopyrite and goethite (Averill 1999). Within the weathering profile, most sulphide minerals are unstable except chalcopyrite and to a lesser degree, sphalerite. In general, pyrite is not preserved (Averill 1999). In the Upper Vermilion River watershed samples, pyrite grains were identified in all but 2 of the samples analysed. Because of its susceptibility to weathering, the pyrite counts reported should be thought of as minimal values only. Commonly, goethite, an iron oxide, occurs in samples with pyrite grains.

In order to obtain background information for the Upper Vermilion River watershed, 19 samples were processed for MMSIMs. These included 7 stream sediment samples, 4 till samples, 3 outwash samples and 5 samples of ice-contact stratified sediments from eskers. The results of these analyses are summarized below and presented in Appendix D.

The abundance of MMSIMs is quite variable in samples from the Upper Vermilion River watershed. However, 2 main assemblages of MMSIMs can be recognized. One assemblage, the most common, is chlorite dominated and the other is a pyrite-dominated assemblage (Figure 22). The pyrite-dominated assemblage occurs predominantly within the central part of the study area, but north of known iron formation outcrops. The pyrite-dominated assemblage occurs in esker sediments sampled north of McLeod Lake (98-PJB-7-1-1, 150 grains of pyrite) and south of Osbourne Lake (98-PJB-6-1-1, 250 grains of pyrite) to the west of the watershed. A pyrite-dominated assemblage with an estimated 150 pyrite grains occurs in a Vermilion River stream sediment sample taken about 5 km north of Milnet (98-PJB-40-1-1) that also contained 20% goethite.

Most of the other MMSIMs occur in low to very low amounts. For example, only 4 gahnite grains were identified and they occurred in 4 different samples: 98-PJB-1-1-1, 98-PJB-8-1-1, 98-PJB-23-1-1 and 98-PJB-50-1-1. Red rutile grains occur in relatively high amounts in outwash samples taken south of the North Range within the Sudbury Basin proper (samples 98-PJB-2-1-1, 98-PJB-2-3-1) and in samples 98-PJB-1-1-1 (ice-contact stratified sediment) and 98-PJB-50-1-1 (stream sediment).

Conclusions

The prediction of sample site locations using GIS was very helpful in the initial stages of project planning. It provided targets for which daily field traverses could be planned. However, site prediction was only as good as the quality of information on the digital base maps used. Most predicted sites that proved to be of no use, were the result of the original map information being in error, or not consistent with present-day conditions. Several of the other predicted sites were not sampled due to time or access constraints, however, for many, alternative sites were selected following the same general principles.

Gold grain content in the samples analyzed is for the most part low. The content of gold grains in outwash sediment appears to be generally too low to be considered economic as a placer gold deposit. However, exceptions may exist in areas not sampled. In addition, gold extraction may become economically viable if mineral aggregate is considered a by-product. Several areas of possible interest are flagged by this study that might warrant follow-up.

KIM results are not as promising. However, 1 sample, 98-PJB-50-1-1, did contain several KIMs including 3 "G9" pyrope garnets. This sample's location, near several intersecting faults, is of interest.

The pyrite-assemblage of the MMSIMs is also interesting. It may be the result of unmapped iron formation subcrops, however, most samples occur north, up flow, from the known zone of this rock-type's outcrops.

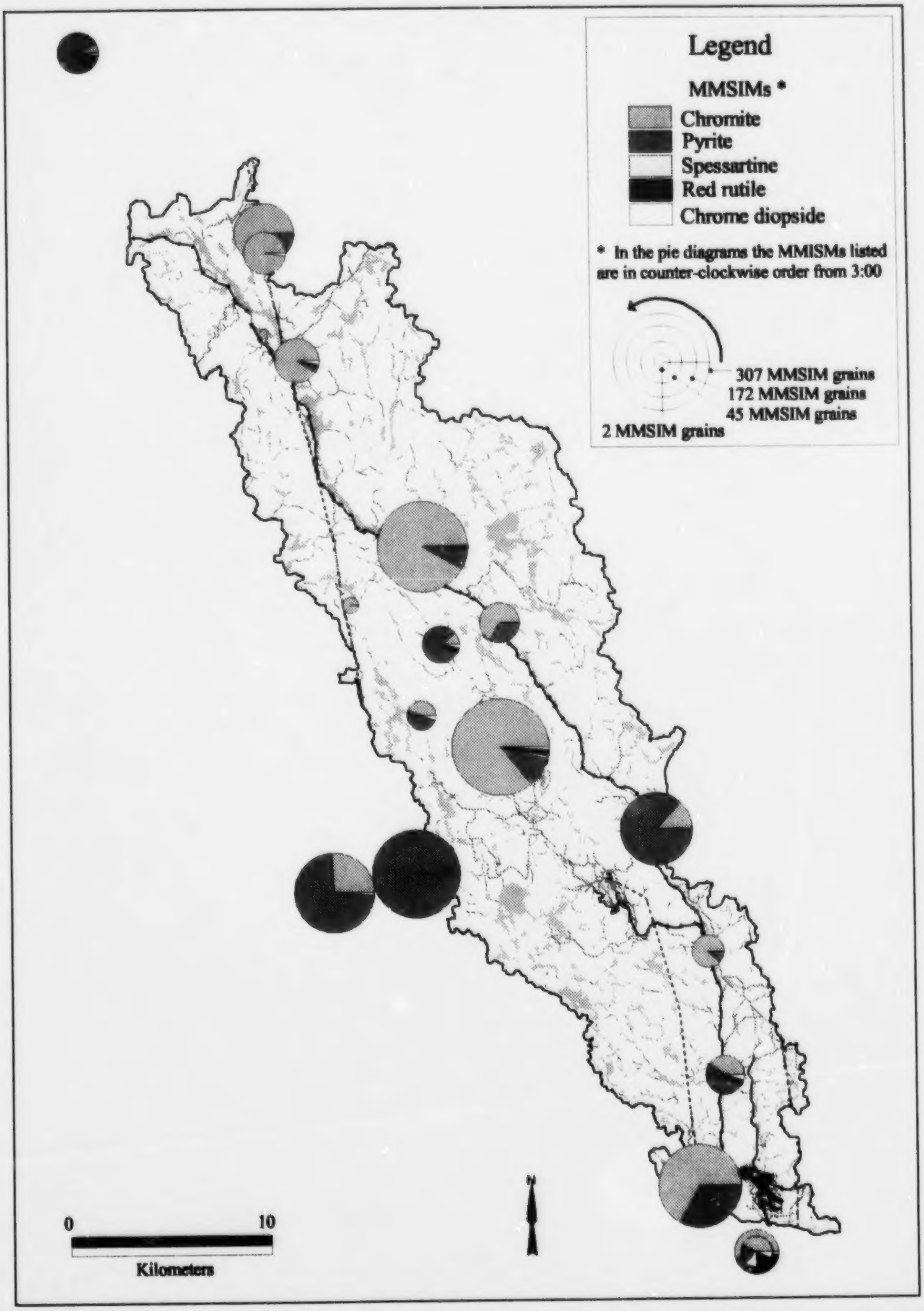

Figure 22. Metamorphosed/magmatic massive sulphide indicator minerals in selected samples determined by Overburden Drilling Management.

Acknowledgements

This work was supported by the Ontario Geological Survey, Ministry of Northern Development and Mines and done in co-operation with the Department of Geography, Laurentian University. The writer would also like to thank S. Leney for his assistance during fieldwork, processing digital files and for many valuable discussions throughout the duration of the project. The Canadian National Railways provided assistance with access during the field component of the project, which was gratefully appreciated.

Research into an integrated exploration methodology based on GIS and statistical analyses to aid in the interpretation of stream sediment results from the Upper Vermilion River watershed is continuing at the Department of Geography, Laurentian University (D.A. Dempsey and J. Robitaille, B.Sc. thesis in progess).

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Appendix A: **Sample location, type and processing information.**

Explanations:

1) Location of sample sites in "*Easting*" and "*Northing*" of the Universal Transverse Mercator or UTM grid system, Zone 17, NAD 27.
2) In "*Kim Processing*" column: y = yes, sample analyzed for kimberlite and metamorphic/magmatic massive sulphide indicator minerals; n = no, samples only processed for gold.

Station Number	Easting	Northing	Interpretation	Landform Interpretation	KIM Processing
98-PJB-1-1-1	470540	5232430	ice-contact stratified sediment	esker	y
98-PJB-2-1-1	505550	5169040	outwash	delta	y
98-PJB-2-2-1	505550	5169040	outwash	delta	n
98-PJB-2-3-1	505550	5169040	outwash	delta	y
98-PJB-3-1-1	504870	5172720	ice-contact stratified sediment	esker	n
98-PJB-4-1-1	505690	5172150	outwash	sandur (outwash plain)	n
98-PJB-5-1-1	491760	5186955	ice-contact stratified sediment	esker	n
98-PJB-6-1-1	487875	5189030	ice-contact stratified sediment	esker	y
98-PJB-7-1-1	483580	5188080	ice-contact stratified sediment	esker	y
98-PJB-8-1-1	503170	5184850	outwash	valley train (valley sandur)	y
98-PJB-9-1-1	494260	5191170	outwash	valley train (valley sandur)	n
98-PJB-10-1-1	489095	5198495	till (flowtill)	lee-side cavity fill	n
98-PJB-11-1-1	483815	5206445	outwash	valley train (valley sandur)	n
98-PJB-12-1-1	498980	5185625	outwash	valley train (valley sandur)	n
98-PJB-13-1-1	502020	5175487	stream sediment	river riffle	n
98-PJB-14-1-1	502620	5172535	ice-contact stratified sediment	esker	y
98-PJB-15-1-1	501560	5171250	outwash	sandur (outwash plain)	n
98-PJB-16-1-1	506550	5170875	stream sediment	river longitudinal bar	n
98-PJB-17-1-1	503585	5172895	stream sediment	river transverse bar	n
98-PJB-18-1-1	503820	5174825	stream sediment	river transverse bar	n
98-PJB-19-1-1	504100	5175321	stream sediment	river longitudinal bar	n
98-PJB-20-1-1	503890	5175786	stream sediment	river point bar	n
98-PJB-21-1-1	503750	5174580	outwash	valley train (valley sandur)	n
98-PJB-22-1-1	503900	5177340	stream sediment	river longitudinal bar	n
98-PJB-23-1-1	504005	5178343	stream sediment	river longitudinal bar	y
98-PJB-24-1-1	503690	5181335	stream sediment	river point bar	n
98-PJB-25-1-1	503788	5181335	stream sediment	river point bar	n
98-PJB-26-1-1	503770	5181210	outwash	valley train (valley sandur)	n
98-PJB-27-1-1	506570	5172680	stream sediment	river longitudinal bar	n
98-PJB-28-1-1	489300	5201060	till	ground moraine	y
98-PJB-29-1-1	489324	5201045	stream sediment	river riffle	n
98-PJB-30-1-1	489040	5201050	stream sediment	river point bar	y
98-PJB-31-1-1	488880	5200467	outwash	valley train (valley sandur)	n
98-PJB-32-1-1	488230	5197350	till	ground moraine	y
98-PJB-33-1-1	505396	5176170	outwash	valley train (valley sandur)	n
98-PJB-34-1-1	505555	5177939	stream sediment	river longitudinal bar	n
98-PJB-35-1-1	505685	5180670	outwash	valley train (valley sandur)	n
98-PJB-36-1-1	504355	5186583	stream sediment	river longitudinal bar	n
98-PJB-37-1-1	501847	5185119	stream sediment	river point bar	n
98-PJB-38-1-1	500490	5189917	stream sediment	river point bar	n
98-PJB-39-1-1	499983	5190739	stream sediment	river point bar	n
98-PJB-40-1-1	500508	5191284	stream sediment	river longitudinal bar	y
98-PJB-41-1-1	500360	5189583	stream sediment	river point bar	n
98-PJB-42-1-1	499418	5186380	stream sediment	river point bar	n
98-PJB-43-1-1	498217	5185295	till (flowtill)	end moraine	n
98-PJB-44-1-1	499214	5185360	stream sediment	river channel	n
98-PJB-45-1-1	494944	5190165	stream sediment	river riffle	n
98-PJB-46-1-1	494096	5192680	stream sediment	river transverse bar	n
98-PJB-47-1-1	494098	5193432	outwash	valley train (valley sandur)	n
98-PJB-48-1-1	493445	5192280	outwash	valley train (valley sandur)	n
98-PJB-48-2-1	493445	5192280	outwash	valley train (valley sandur)	n
98-PJB-49-1-1	493395	5192311	outwash	valley train (valley sandur)	n
98-PJB-49-2-1	493395	5192311	outwash	valley train (valley sandur)	n
98-PJB-50-1-1	492350	5195650	stream sediment	river riffle	y
98-PJB-51-1-1	491750	5199300	outwash	valley train (valley sandur)	n
98-PJB-52-1-1	492000	5198950	stream sediment	river riffle	n
98-PJB-53-1-1	490900	5198650	outwash	valley train (valley sandur)	n

Station Number	Easting	Northing	Interpretation	Landform Interpretation	KIM Processing
98-PJB-54-1-1	491750	5196750	outwash	valley train (valley sandur)	n
98-PJB-55-1-1	492100	5195500	outwash	valley train (valley sandur)	n
98-PJB-56-1-1	503294	5186550	outwash	valley train (valley sandur)	n
98-PJB-57-1-1	491516	5188040	stream sediment	river channel	n
98-PJB-58-1-1	491260	5188665	outwash	valley train (valley sandur)	n
98-PJB-59-1-1	490480	5187755	till (flowtill)	end moraine	n
98-PJB-60-1-1	480168	5222839	ice-contact stratified sediment	esker	n
98-PJB-61-1-1	480217	5222777	ice-contact stratified sediment	esker	y
98-PJB-62-1-1	480245	5221745	till	ground moraine	y
98-PJB-63-1-1	481063	5217537	outwash	valley train (valley sandur)	n
98-PJB-64-1-1	478895	5219096	stream sediment	river channel	n
98-PJB-65-1-1	480194	5218745	stream sediment	beach bar	n
98-PJB-66-1-1	480909	5218304	stream sediment	river channel	n
98-PJB-67-1-1	480808	5217440	stream sediment	river riffle	n
98-PJB-68-1-1	477185	5221564	outwash	valley train (valley sandur)	n
98-PJB-69-1-1	475864	5222823	stream sediment	river longitudinal bar	n
98-PJB-70-1-1	475700	5223788	outwash	sandur (outwash plain)	n
98-PJB-71-1-1	476890	5222625	stream sediment	river point bar	n
98-PJB-72-1-1	478270	5220873	stream sediment	river longitudinal bar	n
98-PJB-73-1-1	481890	5216075	stream sediment	delta	y
98-PJB-74-1-1	482566	5214715	stream sediment	delta	n
98-PJB-75-1-1	483315	5214063	stream sediment	delta	n
98-PJB-76-1-1	482176	5214000	stream sediment	delta	n
98-PJB-77-1-1	483351	5212393	stream sediment	beach bar	n
98-PJB-78-1-1	483173	5210589	stream sediment	beach bar	n
98-PJB-79-1-1	483140	5210475	stream sediment	delta	n
98-PJB-80-1-1	482758	5212270	outwash	valley train (valley sandur)	n
98-PJB-81-1-1	481305	5215675	outwash	valley train (valley sandur)	n
98-PJB-82-1-1	478652	5219276	outwash	valley train (valley sandur)	n
98-PJB-83-1-1	483450	5209274	stream sediment	delta	n
98-PJB-84-1-1	483727	5209595	stream sediment	river transverse bar	n
98-PJB-85-1-1	488370	5206216	stream sediment	river channel	y
98-PJB-86-1-1	485992	5207450	stream sediment	river point bar	n
98-PJB-87-1-1	484750	5207675	stream sediment	river longitudinal bar	n
98-PJB-88-1-1	483712	5208402	outwash	valley train (valley sandur)	n
98-PJB-89-1-1	484563	5203160	till	ground moraine	y
98-PJB-90-1-1	492375	5202182	stream sediment	river transverse bar	y
98-PJB-91-1-1	492604	5202043	stream sediment	river channel	n
98-PJB-92-1-1	492711	5201375	stream sediment	river point bar	n
98-PJB-93-1-1	493903	5200611	stream sediment	river point bar	n
98-PJB-94-1-1	494200	5199080	stream sediment	river point bar	n
98-PJB-95-1-1	494714	5198652	stream sediment	delta	n
98-PJB-96-1-1	494918	5198463	outwash	valley train (valley sandur)	n
98-PJB-97-1-1	503963	5182675	stream sediment	river point bar	n
98-PJB-98-1-1	503431	5184604	stream sediment	river longitudinal bar	n
98-AFB-4001	506260	5170500	till (flowtill)	end moraine	n
98-AFB-4055	501325	5172700	till (flowtill)	end moraine	n
98-AFB-4056	500700	5173250	till	ground moraine	n
98-AFB-4059	506800	5181600	till (flowtill)	lee-side cavity fill	n
98-AFB-4064	507100	5179260	till	ground moraine	n
98-AFB-4065	507250	5178425	till	ground moraine	n
98-AFB-4066	507360	5177340	till	ground moraine	n
98-AFB-4155	500550	5173950	till (flowtill)	lee-side cavity fill	n
98-AFB-4158	503625	5171300	till (flowtill)	end moraine	n
98-AFB-4159	505300	5170900	till (flowtill)	end moraine	n
98-AFB-4160	507870	5172850	till (flowtill)	lee-side cavity fill	n
98-AFB-4162	507700	5170250	till (flowtill)	end moraine	n

Station Number	Easting	Northing	Interpretation	Landform Interpretation	KIM Processing
98-AFB-4163	507700	5170770	till (flowtill)	end moraine	n
98-AFB-4164	503660	5173800	till	ground moraine	n
98-AFB-4165	503500	5175540	till	ground moraine	n
98-AFB-4184	497650	5182200	till (flowtill)	end moraine	n
98-AFB-4186	500750	5176250	till (flowtill)	lee-side cavity fill	n
98-AFB-4187	499300	5177150	till (flowtill)	end moraine	n
98-AFB-4216	502200	5174450	till	ground moraine	n
98-AFB-4217	502200	5175600	till (flowtill)	lee-side cavity fill	n
98-AFB-4218	502000	5177100	till	ground moraine	n

Appendix B: **Summary gold grain processing data.**

Explanations:

1) "*Reshaped*", "*modified*" and "*pristine*" are terms developed to describe the shape of gold grains and are used by some to determine distance of grain transport (DiLabio 1990, Averill 1999).
2) "*Ratio (P+M)/T*" is the ratio of pristine and modified gold grains to the total amount of gold grains in each sample (Bajc 1994). It is used by some to determine or indicate distance sample is away from the gold source (Bajc 1994, DiLabio 1990, Averill 1999).

Station Number	Easting	Northing	Table Split (kg)	+2mm Clasts (kg)	Table Feed (kg)	Total Gold (grains)	Reshaped (grains)	Modified (grains)	Pristine (grains)	Ratio (P+M)/T
98-PJB-1-1-1	470540	5232430	8.1	2.6	5.5	0	0	0	0	-
98-PJB-2-1-1	505550	5169040	8.4	2.4	6.1	2	1	1	0	0.5
98-PJB-2-2-1	505550	5169040	7.3	0.6	6.7	0	0	0	0	-
98-PJB-2-3-1	505550	5169040	7.1	0.1	7.1	2	2	0	0	0.0
98-PJB-3-1-1	504870	5172720	7.5	1.8	5.7	1	0	1	0	1.0
98-PJB-4-1-1	505690	5172150	7.9	3.1	4.8	1	1	0	0	0.0
98-PJB-5-1-1	491760	5186955	8.1	5.7	2.4	1	1	0	0	0.0
98-PJB-6-1-1	487875	5189030	9.4	4.5	4.9	3	3	0	0	0.0
98-PJB-7-1-1	483580	5188080	9.2	5.5	3.8	0	0	0	0	-
98-PJB-8-1-1	503170	5184850	7.4	2.4	5.1	0	0	0	0	-
98-PJB-9-1-1	494260	5191170	6.3	1.9	4.4	0	0	0	0	-
98-PJB-10-1-1	489095	5198495	6.8	1.4	5.4	0	0	0	0	-
98-PJB-11-1-1	483815	5206445	7.8	5.4	2.5	5	3	1	1	0.4
98-PJB-12-1-1	498980	5185625	7.7	2.6	5.1	2	2	0	0	0.0
98-PJB-13-1-1	502020	5175487	9.1	5.2	3.9	0	0	0	0	-
98-PJB-14-1-1	502620	5172535	8.3	3.2	5.1	1	1	0	0	0.0
98-PJB-15-1-1	501560	5171250	8.9	2.5	6.4	0	0	0	0	-
98-PJB-16-1-1	506550	5170875	10.7	3.8	6.9	6	4	2	0	0.3
98-PJB-17-1-1	503585	5172895	9.8	8.2	1.7	0	0	0	0	-
98-PJB-18-1-1	503820	5174825	10	4.4	5.6	0	0	0	0	-
98-PJB-19-1-1	504100	5175321	7.3	4.9	2.4	0	0	0	0	-
98-PJB-20-1-1	503890	5175786	10.8	1.7	9.1	0	0	0	0	-
98-PJB-21-1-1	503750	5174580	9.4	4.1	5.4	0	0	0	0	-
98-PJB-22-1-1	503900	5177340	10	0.9	9.1	2	0	2	0	1.0
98-PJB-23-1-1	504005	5178343	8.8	2	6.8	0	0	0	0	-
98-PJB-24-1-1	503690	5181335	8.2	3	5.2	0	0	0	0	-
98-PJB-25-1-1	503788	5181335	9.5	2.7	6.9	0	0	0	0	-
98-PJB-26-1-1	503770	5181210	8.2	5.3	2.9	0	0	0	0	-
98-PJB-27-1-1	506570	5172680	9.9	4.5	5.4	1	1	0	0	0.0
98-PJB-28-1-1	489300	5201060	8	1.3	6.7	5	4	1	0	0.2
98-PJB-29-1-1	489324	5201045	8.8	3.2	5.7	0	0	0	0	-
98-PJB-30-1-1	489040	5201050	9.2	0.1	9.1	0	0	0	0	-
98-PJB-31-1-1	488880	5200467	7.7	2.7	5	4	2	0	2	0.5
98-PJB-32-1-1	488230	5197350	6.8	0.9	5.9	4	3	0	1	0.3
98-PJB-33-1-1	505396	5176170	10.1	3.1	7	0	0	0	0	-
98-PJB-34-1-1	505555	5177939	11.3	5.2	6.1	0	0	0	0	-
98-PJB-35-1-1	505685	5180670	9.4	3.1	6.3	30	30	0	0	0.0
98-PJB-36-1-1	504355	5186583	9.5	0.8	8.7	7	7	0	0	0.0
98-PJB-37-1-1	501847	5185119	10.3	5.2	5.2	2	2	0	0	0.0
98-PJB-38-1-1	500490	5189917	12.4	6.8	5.7	0	0	0	0	-
98-PJB-39-1-1	499983	5190739	12	6.4	5.7	0	0	0	0	-
98-PJB-40-1-1	500508	5191284	9.2	3.4	5.9	0	0	0	0	-
98-PJB-41-1-1	500360	5189583	12.4	7.1	5.4	0	0	0	0	-

Station Number	Easting	Northing	Table Split (kg)	+2mm Clasts (kg)	Table Feed (kg)	Total Gold (grains)	Reshaped (grains)	Modified (grains)	Pristine (grains)	Ratio (P+M)/T
98-PJB-42-1-1	499418	5186380	10.7	7.7	3.1	0	0	0	0	-
98-PJB-43-1-1	498217	5185295	10.7	2.7	8	3	2	1	0	0.3
98-PJB-44-1-1	499214	5185360	12.2	6.9	5.4	3	3	0	0	0.0
98-PJB-45-1-1	494944	5190165	10.6	2.5	8.1	0	0	0	0	-
98-PJB-46-1-1	494096	5192680	8.7	4	4.8	0	0	0	0	-
98-PJB-47-1-1	494098	5193432	5	1.5	3.5	4	3	0	1	0.3
98-PJB-48-1-1	493445	5192280	9.9	1.3	8.6	0	0	0	0	-
98-PJB-48-2-1	493445	5192280	9.2	3.1	6.2	6	6	0	0	0.0
98-PJB-49-1-1	493395	5192311	9.1	0	9.1	1	1	0	0	0.0
98-PJB-49-2-1	493395	5192311	10.1	1.8	8.4	4	3	1	0	0.3
98-PJB-50-1-1	492350	5195650	10.5	3.3	7.2	1	1	0	0	0.0
98-PJB-51-1-1	491750	5199300	9.9	4.1	5.8	22	22	0	0	0.0
98-PJB-52-1-1	492000	5198950	10.4	3.2	7.2	2	2	0	0	0.0
98-PJB-53-1-1	490900	5198650	10.1	3.2	6.9	1	1	0	0	0.0
98-PJB-54-1-1	491750	5196750	11.1	6.1	5	0	0	0	0	-
98-PJB-55-1-1	492100	5195500	9.7	3.4	6.3	17	17	0	0	0.0
98-PJB-56-1-1	503294	5186550	10.6	3.6	7	12	12	0	0	0.0
98-PJB-57-1-1	491516	5188040	10.7	5	5.7	0	0	0	0	-
98-PJB-58-1-1	491260	5188665	10.5	3.5	7	0	0	0	0	-
98-PJB-59-1-1	490480	5187755	9.4	2.5	6.9	3	3	0	0	0.0
98-PJB-60-1-1	480168	5222839	9.6	3.8	5.8	0	0	0	0	-
98-PJB-61-1-1	480217	5222777	10.2	4.5	5.7	1	0	1	0	1.0
98-PJB-62-1-1	480245	5221745	9.6	1.9	7.8	3	1	2	0	0.7
98-PJB-63-1-1	481063	5217537	9.7	2.4	7.3	4	4	0	0	0.0
98-PJB-64-1-1	478895	5219096	11.7	4.9	6.8	2	2	0	0	0.0
98-PJB-65-1-1	480194	5218745	11.6	0.7	10.9	0	0	0	0	-
98-PJB-66-1-1	480909	5218304	10.9	0.1	10.9	2	2	0	0	0.0
98-PJB-67-1-1	480808	5217440	10	3.1	6.9	1	1	0	0	0.0
98-PJB-68-1-1	477185	5221564	9.9	5.9	4	0	0	0	0	-
98-PJB-69-1-1	475864	5222823	9.1	4.1	5	0	0	0	0	-
98-PJB-70-1-1	475700	5223788	9.4	0	9.4	9	7	2	0	0.2
98-PJB-71-1-1	476890	5222625	9.3	0	9.3	2	2	0	0	0.0
98-PJB-72-1-1	478270	5220873	9.1	3.6	5.5	0	0	0	0	-
98-PJB-73-1-1	481890	5216075	9.6	0.1	9.5	1	1	0	0	0.0
98-PJB-74-1-1	482566	5214715	9.3	0.5	8.8	0	0	0	0	-
98-PJB-75-1-1	483315	5214063	9.6	0.1	9.5	4	3	1	0	0.3
98-PJB-76-1-1	482176	5214000	9.6	0.7	8.9	2	2	0	0	0.0
98-PJB-77-1-1	483351	5212393	8.5	1	7.5	0	0	0	0	-
98-PJB-78-1-1	483173	5210589	8.9	0.3	8.6	0	0	0	0	-
98-PJB-79-1-1	483140	5210475	8.5	0.1	8.4	4	4	0	0	0.0
98-PJB-80-1-1	482758	5212270	8.9	5.4	3.5	0	0	0	0	-
98-PJB-81-1-1	481305	5215675	8.6	3.2	5.5	2	2	0	0	0.0
98-PJB-82-1-1	478652	5219276	8.8	2.8	6	1	1	0	0	0.0

Station Number	Easting	Northing	Table Split (kg)	+2mm Clasts (kg)	Table Feed (kg)	Total Gold (grains)	Reshaped (grains)	Modified (grains)	Pristine (grains)	Ratio (P+M)/T
98-PJB-83-1-1	483450	5209274	9.3	2	7.4	3	3	0	0	0.0
98-PJB-84-1-1	483727	5209595	8.7	2.9	5.8	1	1	0	0	0.0
98-PJB-85-1-1	488370	5206216	9.5	4.9	4.6	1	1	0	0	0.0
98-PJB-86-1-1	485992	5207450	7.9	1.2	6.7	2	1	0	1	0.5
98-PJB-87-1-1	484750	5207675	8.6	2.4	6.2	3	3	0	0	0.0
98-PJB-88-1-1	483712	5208402	8	4	4.1	0	0	0	0	-
98-PJB-89-1-1	484563	5203160	9	1.2	7.9	0	0	0	0	-
98-PJB-90-1-1	492375	5202182	9.6	4.1	5.5	0	0	0	0	-
98-PJB-91-1-1	492604	5202043	9.2	0	9.2	2	2	0	0	0.0
98-PJB-92-1-1	492711	5201375	9	0.5	8.6	0	0	0	0	-
98-PJB-93-1-1	493903	5200611	9.5	0	9.5	4	4	0	0	0.0
98-PJB-94-1-1	494200	5199080	9	1.8	7.3	2	2	0	0	0.0
98-PJB-95-1-1	494714	5198652	8.7	0.2	8.5	0	0	0	0	-
98-PJB-96-1-1	494918	5198463	10	1.5	8.5	0	0	0	0	-
98-PJB-97-1-1	503963	5182675	9	3.9	5.2	0	0	0	0	-
98-PJB-98-1-1	503431	5184604	8.7	5.4	3.4	0	0	0	0	-
98-AFB-4001	506260	5170500	6.7	1.9	4.9	6	6	0	0	0.0
98-AFB-4055	501325	5172700	8.2	1.2	7	0	0	0	0	-
98-AFB-4056	500700	5173250	7.6	1.3	6.3	3	3	0	0	0.0
98-AFB-4059	506800	5181600	8.7	1.9	6.8	2	1	0	1	0.5
98-AFB-4064	507100	5179260	8.3	0.8	7.5	6	3	0	3	0.5
98-AFB-4065	507250	5178425	7.8	0.9	7	2	2	0	0	0.0
98-AFB-4066	507360	5177340	7	0.8	6.2	7	6	0	1	0.0
98-AFB-4155	500550	5173950	8.5	1.7	6.9	3	2	0	1	0.3
98-AFB-4158	503625	5171300	8.5	2.5	6	4	4	0	0	0.0
98-AFB-4159	505300	5170900	8.5	1.1	7.4	42	30	10	2	0.3
98-AFB-4160	507870	5172850	10	1.4	8.6	7	6	1	0	0.1
98-AFB-4162	507700	5170250	9.2	2.4	6.8	10	8	0	2	0.2
98-AFB-4163	507700	5170770	8.8	1.5	7.3	1	1	0	0	0.0
98-AFB-4164	503660	5173800	7.9	1.2	6.7	6	6	0	0	0.0
98-AFB-4165	503500	5175540	8.9	2.8	6.1	1	0	0	1	1.0
98-AFB-4184	497650	5182200	9.8	3	6.8	1	1	0	0	0.0
98-AFB-4186	500750	5176250	8.9	0.8	8.1	8	8	0	0	0.0
98-AFB-4187	499300	5177150	10	2.8	7.3	3	3	0	0	0.0
98-AFB-4216	502200	5174450	7.6	1.8	5.8	0	0	0	0	-
98-AFB-4217	502200	5175600	8.1	1.8	6.4	4	4	0	0	0.0
98-AFB-4218	502000	5177100	7.6	1.8	5.8	5	5	0	0	0.0

Appendix C: **Summary of picked and estimated kimberlite indicator mineral grain data.**

Explanations:

1) The first table includes the number of picked grains by Overburden Drilling Management (ODM) and the second table contains the amount of estimated grains (ODM) adjusted as the result of the geochemistry (Appendix F) done on the picked grains.

Abbreviations used in tables:
GP = Purple garnet
GO = Orange garnet
DC = Chrome diopside
IM = Ilmenite
CR = Chromite
FO = Foresterite
CR est = ODM grain estimate
CR act = number of picked chromite grains of possible "kimberlitic" association.
"*Total KIMs*" (last column of second table) = the total estimated number of kimberlite indicator minerals used in plots on Figure 17.

IMPORTANT NOTE CONCERNING THE FOLLOWING PAGES

THE PAGES WHICH FOLLOW HAVE BEEN FILMED TWICE IN ORDER TO OBTAIN THE BEST REPRODUCTIVE QUALITY

USERS SHOULD CONSULT ALL THE PAGES REPRODUCED ON THE FICHE IN ORDER TO OBTAIN A COMPLETE READING OF THE TEXT.

REMARQUE IMPORTANTE CONCERNANT LES PAGES QUI SUIVENT

LES PAGES SUIVANTES ONT ÉTÉ REPRODUITES EN DOUBLE AFIN D'AMÉLIORER LA QUALITÉ DE REPRODUCTION

LES UTILISATEURS DOIVENT CONSULTER TOUTES LES PAGES REPRODUITES SUR LA FICHE AFIN D'OBTENIR LA LECTURE DU TEXTE INTÉGRAL

Sample Number (98-PJB-)	easting	northing	KIM Counts																	
			1.0 to 2.0 mm						0.5 to 1 mm						0.25 to 0.5 mm					Total
			GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	CR	FO	KIMs
1-1-1	470540	5232430	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	3
2-1-1	505550	5169040	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	5	1	7
2-3-1	505550	5169040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
6-1-1	487875	5189030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
7-1-1	483580	5188080	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	15	0	19
8-1-1	503170	5184850	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	19	0	23
14-1-1	502620	5172535	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	6
23-1-1	504005	5178343	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10	0	16
28-1-1	489300	5201060	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	4
30-1-1	489040	5201050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
32-1-1	488230	5197350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10
40-1-1	500508	5191284	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10
50-1-1	492350	5195650	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	21	0	22
61-1-1	480217	5222777	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	15	0	20
62-1-1	480245	5221745	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10	0	11
73-1-1	481890	5216075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10
85-1-1	488370	5206216	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	15	0	19
89-1-1	484563	5203160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
90-1-1	492375	5202182	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	7
Total			0	0	0	0	0	0	0	0	0	0	20	0	2	2	3	163	1	194

Sample Number	KIM Estimates																		
	1.0 to 2.0 mm						0.5 to 1 mm						0.25 to 0.5 mm						Total
	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	DC	CR	CR est	CR act	FO	KIMs
98-PJB-1-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	2	0	3
98-PJB-2-1-1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	30	5	1	7
98-PJB-2-3-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	10	3	0	3
98-PJB-6-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
98-PJB-7-1-1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	15	50	15	0	19
98-PJB-8-1-1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	19	150	19	0	23
98-PJB-14-1-1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	20	5	0	6
98-PJB-23-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	60	10	0	16
98-PJB-28-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	3	3	0	4
98-PJB-30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
98-PJB-32-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	0	10
98-PJB-40-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	25	10	0	10
98-PJB-50-1-1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	21	275	21	0	22
98-PJB-61-1-1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	15	100	15	0	20
98-PJB-62-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	50	10	0	11
98-PJB-73-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	50	10	0	10
98-PJB-85-1-1	0	0	0	0	0	0	0	0	0	0	3	0	0	1	15	250	15	0	19
98-PJB-89-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	2
98-PJB-90-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	30	7	0	7
Total	0	0	0	0	0	0	0	0	0	0	20	0	2	3	163	1118	163	1	194

Sample Number	Estimated	
		Total
	CR	KIMs
98-PJB-1-1-1	2	3
98-PJB-2-1-1	30	33
98-PJB-2-3-1	10	10
98-PJB-6-1-1	1	1
98-PJB-7-1-1	50	54
98-PJB-8-1-1	150	153
98-PJB-14-1-1	20	21
98-PJB-23-1-1	60	61
98-PJB-28-1-1	3	4
98-PJB-30-1-1	0	1
98-PJB-32-1-1	10	10
98-PJB-40-1-1	25	25
98-PJB-50-1-1	275	277
98-PJB-61-1-1	100	104
98-PJB-62-1-1	50	51
98-PJB-73-1-1	50	50
98-PJB-85-1-1	250	254
98-PJB-89-1-1	2	2
98-PJB-90-1-1	30	30

Sample Number (98–PJB-)	easting	northing	KIM Counts																	
			1.0 to 2.0 mm						0.5 to 1 mm						0.25 to 0.5 mm					Total
			GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	GO	DC	CR	FO	KIMs
1-1-1	470540	5232430	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	**2**	0	3
2-1-1	505550	5169040	0	0	0	0	0	0	0	0	0	0	**2**	0	0	0	0	**5**	**1**	7
2-3-1	505550	5169040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**	0	3
6-1-1	487875	5189030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	1
7-1-1	483580	5188080	0	0	0	0	0	0	0	0	0	0	**4**	0	0	0	0	**15**	0	19
8-1-1	503170	5184850	0	0	0	0	0	0	0	0	0	0	**3**	0	0	0	0	**19**	0	23
14-1-1	502620	5172535	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	**5**	0	6
23-1-1	504005	5178343	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	**10**	0	16
28-1-1	489300	5201060	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	**3**	0	4
30-1-1	489040	5201050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	1
32-1-1	488230	5197350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	10
40-1-1	500508	5191284	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	10
50-1-1	492350	5195650	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**2**	**1**	**21**	0	22
61-1-1	480217	5222777	0	0	0	0	0	0	0	0	0	0	**4**	0	0	0	0	**15**	0	20
62-1-1	480245	5221745	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	**10**	0	11
73-1-1	481890	5216075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	10
85-1-1	488370	5206216	0	0	0	0	0	0	0	0	0	0	**3**	0	0	0	**1**	**15**	0	19
89-1-1	484563	5203160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**	0	2
90-1-1	492375	5202182	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**7**	0	7
Total			0	0	0	0	0	0	0	0	0	0	20	0	2	2	3	163	1	194

Sample Number	KIM Estimates																		
	1.0 to 2.0 mm						0.5 to 1 mm						0.25 to 0.5 mm						Total
	GP	GO	DC	IM	CR	FO	GP	GO	DC	IM	CR	FO	GP	DC	CR	CR est	CR act	FO	KIMs
98-PJB-1-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	2	0	3
98-PJB-2-1-1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	30	5	1	7
98-PJB-2-3-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	10	3	0	3
98-PJB-6-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
98-PJB-7-1-1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	15	50	15	0	19
98-PJB-8-1-1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	19	150	19	0	23
98-PJB-14-1-1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	20	5	0	6
98-PJB-23-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	60	10	0	16
98-PJB-28-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	3	3	0	4
98-PJB-30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
98-PJB-32-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	0	10
98-PJB-40-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	25	10	0	10
98-PJB-50-1-1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	21	275	21	0	22
98-PJB-61-1-1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	15	100	15	0	20
98-PJB-62-1-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	50	10	0	11
98-PJB-73-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	50	10	0	10
98-PJB-85-1-1	0	0	0	0	0	0	0	0	0	0	3	0	0	1	15	250	15	0	19
98-PJB-89-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	2
98-PJB-90-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	30	7	0	7
Total	0	0	0	0	0	0	0	0	0	0	20	0	2	3	163	1118	163	1	194

Sample Number	Estimated	
		Total
	CR	KIMs
98-PJB-1-1-1	2	3
98-PJB-2-1-1	30	33
98-PJB-2-3-1	10	10
98-PJB-6-1-1	1	1
98-PJB-7-1-1	50	54
98-PJB-8-1-1	150	153
98-PJB-14-1-1	20	21
98-PJB-23-1-1	60	61
98-PJB-28-1-1	3	4
98-PJB-30-1-1	0	1
98-PJB-32-1-1	10	10
98-PJB-40-1-1	25	25
98-PJB-50-1-1	275	277
98-PJB-61-1-1	100	104
98-PJB-62-1-1	50	51
98-PJB-73-1-1	50	50
98-PJB-85-1-1	250	254
98-PJB-89-1-1	2	2
98-PJB-90-1-1	30	30

Appendix D: **Summary of picked and estimated metamorphic/magmatic massive sulphide indicator mineral (MMSIMs) grain data.**

Abbreviations used in tables:

St = staurolite
An = Anthophyllite
Hy = Hypersthene
Ol = Olivine
Sp = Spessartine
Re = Red epidote
Sa = Sappharine
Cr = Chromite
Rr = Red rutile
Rc = Ruby corundum
Ga = Gahnite
Ch = Calcopyrite
Dc = Chrome diopside

Sample Number (98-PJB-)	Picked Grains														Total MMSIMs	Location	
	METAMORPHOSED MAGMATIC/MASSIVE SULPHIDE INDICATOR MINERALS																
	St	An	Hy	Ol	Sp	Ru	Sa	Cr	Rr	Rc	Ga	Ch	Dc			Easting	Northing
1-1-1	0	0	0	0	0	0	1	3	6	1	1	0	1		13	470540	5232430
2-1-1	0	0	0	0	0	0	0	7	15	0	0	0	1		23	505550	5169040
2-3-1	0	0	0	0	3	0	0	3	4	0	0	0	2		12	505550	5169040
6-1-1	0	0	0	0	0	1	0	1	0	0	0	1	0		3	487875	5189030
7-1-1	0	0	0	0	2	0	0	19	0	0	0	0	0		21	483580	5188080
8-1-1	0	0	0	0	0	0	0	22	0	0	1	0	0		23	503170	5184850
14-1-1	0	0	0	0	0	0	0	5	0	0	0	0	0		5	502620	5172535
23-1-1	0	0	0	0	0	0	0	11	2	1	1	0	2		17	504005	5178343
28-1-1	0	0	0	0	0	0	0	4	2	0	0	0	1		7	489300	5201060
30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	489040	5201050
32-1-1	0	0	0	0	0	0	0	10	0	0	0	0	1		11	488230	5197350
40-1-1	0	0	0	0	0	0	0	10	0	0	0	0	0		10	500508	5191284
50-1-1	0	0	0	0	4	0	0	21	5	1	1	1	5		38	492350	5195650
61-1-1	0	0	0	0	0	0	0	20	0	0	0	0	0		20	480217	5222777
62-1-1	0	0	0	0	0	0	0	11	0	0	0	0	1		12	480245	5221745
73-1-1	0	0	0	0	0	1	0	10	1	3	0	0	2		17	481890	5216075
85-1-1	0	0	0	0	0	0	0	18	2	0	0	0	0		20	488370	5206216
89-1-1	0	0	0	0	0	0	0	2	0	0	0	0	0		2	484563	5203160
90-1-1	0	0	0	0	0	0	0	7	0	0	0	0	0		7	492375	5202182
Total	0	0	0	0	9	2	1	184	37	6	4	2	16		261		

Sample Number (98-PJB-)	Picked Grains: METAMORPHOSED MAGMATIC/MASSIVE SULPHIDE INDICATOR MINERALS														Total MMSIMs	Location	
	St	An	Hy	Ol	Sp	Re	Sa	Cr	Rr	Rc	Ga	Ch	Dc			Easting	Northing
1-1-1	0	0	0	0	0	0	**1**	**3**	**6**	**1**	**1**	0	**1**		13	470540	5232430
2-1-1	0	0	0	0	0	0	0	**7**	**15**	0	0	0	**1**		23	505550	5169040
2-3-1	0	0	0	0	**3**	0	0	**3**	**4**	0	0	0	**2**		12	505550	5169040
6-1-1	0	0	0	0	0	**1**	0	**1**	0	0	0	**1**	0		3	487875	5189030
7-1-1	0	0	0	0	**2**	0	0	**19**	0	0	0	0	0		21	483580	5188080
8-1-1	0	0	0	0	0	0	0	**22**	0	0	**1**	0	0		23	503170	5184850
14-1-1	0	0	0	0	0	0	0	**5**	0	0	0	0	0		5	502620	5172535
23-1-1	0	0	0	0	0	0	0	**11**	**2**	**1**	**1**	0	**2**		17	504005	5178343
28-1-1	0	0	0	0	0	0	0	**4**	**2**	0	0	0	**1**		7	489300	5201060
30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	489040	5201050
32-1-1	0	0	0	0	0	0	0	**10**	0	0	0	0	**1**		11	488230	5197350
40-1-1	0	0	0	0	0	0	0	**10**	0	0	0	0	0		10	500508	5191284
50-1-1	0	0	0	0	**4**	0	0	**21**	**5**	**1**	**1**	**1**	**5**		38	492350	5195650
61-1-1	0	0	0	0	0	0	0	**20**	0	0	0	0	0		20	480217	5222777
62-1-1	0	0	0	0	0	0	0	**11**	0	0	0	0	**1**		12	480245	5221745
73-1-1	0	0	0	0	0	**1**	0	**10**	**1**	**3**	0	0	**2**		17	481890	5216075
85-1-1	0	0	0	0	0	0	0	**18**	**2**	0	0	0	0		20	488370	5206216
89-1-1	0	0	0	0	0	0	0	**2**	0	0	0	0	0		2	484563	5203160
90-1-1	0	0	0	0	0	0	0	**7**	0	0	0	0	0		7	492375	5202182
Total	0	0	0	0	9	2	1	184	37	6	4	2	16		261		

Sample Number (98-PJB-)	Estimated Grains																
	METAMORPHOSED MAGMATIC/MASSIVE SULPHIDE INDICATOR MINERALS														Total	Location	
	St	An	Hy	Ol	Sp	Re	Sa	Cr	Rr	Rc	Ga	Ch	Dc	Py	MMSIMs	Easting	Northing
1-1-1	0	0	0	0	0	0	1	3	6	1	1	0	1	35	48	470540	5232430
2-1-1	0	0	0	0	0	0	0	32	15	0	0	0	1	10	58	505550	5169040
2-3-1	0	0	0	0	3	0	0	10	4	0	0	0	2	5	24	505550	5169040
6-1-1	0	0	0	0	0	1	0	1	0	0	0	1	0	250	253	487875	5189030
7-1-1	0	0	0	0	2	0	0	54	0	0	0	0	0	150	206	483580	5188080
8-1-1	0	0	0	0	0	0	0	22	0	0	1	0	0	3	26	503170	5184850
14-1-1	0	0	0	0	0	0	0	153	0	0	0	0	0	75	228	502620	5172535
23-1-1	0	0	0	0	0	0	0	15	2	1	1	0	2	20	41	504005	5178343
28-1-1	0	0	0	0	0	0	0	4	2	0	0	0	1	30	37	489300	5201060
30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	489040	5201050
32-1-1	0	0	0	0	0	0	0	8	0	0	0	0	1	10	19	488230	5197350
40-1-1	0	0	0	0	0	0	0	21	0	0	0	0	0	150	171	500508	5191284
50-1-1	0	0	0	0	4	0	0	259	5	1	1	1	5	30	306	492350	5195650
61-1-1	0	0	0	0	0	0	0	105	0	0	0	0	0	10	115	480217	5222777
62-1-1	0	0	0	0	0	0	0	51	0	0	0	0	1	0	52	480245	5221745
73-1-1	0	0	0	0	0	1	0	50	1	3	0	0	2	2	59	481890	5216075
85-1-1	0	0	0	0	0	0	0	250	2	0	0	0	0	20	272	488370	5206216
89-1-1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	484563	5203160
90-1-1	0	0	0	0	0	0	0	30	0	0	0	0	0	15	45	492375	5202182
Total	0	0	0	0	9	2	1	1070	37	6	4	2	16	817	1964		

Sample Number	Estimated Grains																
	METAMORPHOSED MAGMATIC/MASSIVE SULPHIDE INDICATOR MINERALS														Total	Location	
(98-PJB-)	St	An	Ily	Ol	Sp	Re	Sa	Cr	Br	Rc	Ga	Ch	Dc	Py	MMSIMs	Easting	Northing
1-1-1	0	0	0	0	0	0	1	3	6	1	1	0	1	35	48	470540	5232430
2-1-1	0	0	0	0	0	0	0	32	15	0	0	0	1	10	58	505550	5169040
2-3-1	0	0	0	0	3	0	0	10	4	0	0	0	2	5	24	505550	5169040
6-1-1	0	0	0	0	0	1	0	1	0	0	0	1	0	250	253	487875	5189030
7-1-1	0	0	0	0	2	0	0	54	0	0	0	0	0	150	206	483580	5188080
8-1-1	0	0	0	0	0	0	0	22	0	0	1	0	0	3	26	503170	5184850
14-1-1	0	0	0	0	0	0	0	153	0	0	0	0	0	75	228	502620	5172535
23-1-1	0	0	0	0	0	0	0	15	2	1	1	0	2	20	41	504005	5178343
28-1-1	0	0	0	0	0	0	0	4	2	0	0	0	1	30	37	489300	5201060
30-1-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	489040	5201050
32-1-1	0	0	0	0	0	0	0	8	0	0	0	0	1	10	19	488230	5197350
40-1-1	0	0	0	0	0	0	0	21	0	0	0	0	0	150	171	500508	5191284
50-1-1	0	0	0	0	4	0	0	259	5	1	1	1	5	30	306	492350	5195650
61-1-1	0	0	0	0	0	0	0	105	0	0	0	0	0	10	115	480217	5222777
62-1-1	0	0	0	0	0	0	0	51	0	0	0	0	1	0	52	480245	5221745
73-1-1	0	0	0	0	0	1	0	50	1	3	0	0	2	2	59	481890	5216075
85-1-1	0	0	0	0	0	0	0	250	2	0	0	0	0	20	272	488370	5206216
89-1-1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	484563	5203160
90-1-1	0	0	0	0	0	0	0	30	0	0	0	0	0	15	45	492375	5202182
Total	0	0	0	0	9	2	1	1070	37	6	4	2	16	817	1964		

9

Appendix E: Sample number/probe number correlation table.

Sample #98-PJB-	Probe Number	Grain Type
14-1-1	GP-1	Pyrope Garnet
50-1-1	GP-2	Pyrope Garnet
2-3-1	Al-1	Almandine
50-1-1	Al-2	Almandine
50-1-1	Al-3	Almandine
50-1-1	Al-4	Almandine
50-1-1	Al-5	Almandine
73-1-1	Al-6	Almandine
73-1-1	Al-7	Almandine
50-1-1	GO-1	Eclogitic Garnet
50-1-1	GO-2	Eclogitic Garnet
85-1-1	AN-1	Andradite
2-3-1	SS-1	Spessartine
2-3-1	SS-2	Spessartine
2-3-1	SS-3	Spessartine
7-1-1	SS-4	Spessartine
7-1-1	SS-5	Spessartine
50-1-1	SS-6	Spessartine
50-1-1	SS-7	Spessartine
50-1-1	SS-8	Spessartine
50-1-1	SS-9	Spessartine
2-1-1	DC-1	Chrome Diopside
2-3-1	DC-2	Chrome Diopside
2-3-1	DC-3	Chrome Diopside
23-1-1	DC-4	Chrome Diopside
23-1-1	DC-5	Chrome Diopside
28-1-1	DC-6	Chrome Diopside
30-1-1	DC-7	Chrome Diopside
32-1-1	DC-8	Chrome Diopside
50-1-1	DC-9	Chrome Diopside
50-1-1	DC-10	Chrome Diopside
50-1-1	DC-11	Chrome Diopside
50-1-1	DC-12	Chrome Diopside
50-1-1	DC-13	Chrome Diopside
50-1-1	DC-14	Chrome Diopside
7-3-1	DC-15	Chrome Diopside
7-3-1	DC-16	Chrome Diopside
62-1-1	DC-17	Chrome Diopside
85-1-1	DC-18	Chrome Diopside
2-1-1	OL-1	Olivine

Sample #98-PJB-	Probe Number	Grain Type
1-1-1	CR-1	Chromite
1-1-1	CR-2	Chromite
2-1-1	CR-3	Chromite
2-1-1	CR-4	Chromite
2-1-1	CR-5	Chromite
2-1-1	CR-6	Chromite
2-1-1	CR-7	Chromite
2-3-1	CR-8	Chromite
2-3-1	CR-9	Chromite
2-3-1	CR-10	Chromite
6-1-1	CR-11	Chromite
7-1-1	CR-12	Chromite
7-1-1	CR-13	Chromite
7-1-1	CR-14	Chromite
7-1-1	CR-15	Chromite
7-1-1	CR-16	Chromite
7-1-1	CR-17	Chromite
7-1-1	CR-18	Chromite
7-1-1	CR-19	Chromite
7-1-1	CR-20	Chromite
7-1-1	CR-21	Chromite
7-1-1	CR-22	Chromite
7-1-1	CR-23	Chromite
7-1-1	CR-24	Chromite
7-1-1	CR-25	Chromite
7-1-1	CR-26	Chromite
8-1-1	CR-27	Chromite
8-1-1	CR-28	Chromite
8-1-1	CR-29	Chromite
8-1-1	CR-30	Chromite
8-1-1	CR-31	Chromite
8-1-1	CR-32	Chromite
8-1-1	CR-33	Chromite
8-1-1	CR-34	Chromite
8-1-1	CR-35	Chromite
8-1-1	CR-36	Chromite
8-1-1	CR-37	Chromite
8-1-1	CR-38	Chromite
8-1-1	CR-39	Chromite
8-1-1	CR-40	Chromite
8-1-1	CR-41	Chromite
8-1-1	CR-42	Chromite
8-1-1	CR-43	Chromite
8-1-1	CR-44	Chromite
8-1-1	CR-45	Chromite
14-1-1	CR-46	Chromite

Sample #98-PJB-	Probe Number	Grain Type
14-1-1	CR-47	Chromite
14-1-1	CR-48	Chromite
14-1-1	CR-49	Chromite
14-1-1	CR-50	Chromite
23-1-1	CR-51	Chromite
23-1-1	CR-52	Chromite
23-1-1	CR-53	Chromite
23-1-1	CR-54	Chromite
23-1-1	CR-55	Chromite
23-1-1	CR-56	Chromite
23-1-1	CR-57	Chromite
23-1-1	CR-58	Chromite
23-1-1	CR-59	Chromite
23-1-1	CR-60	Chromite
28-1-1	CR-61	Chromite
28-1-1	CR-62	Chromite
28-1-1	CR-63	Chromite
32-1-1	CR-64	Chromite
32-1-1	CR-65	Chromite
32-1-1	CR-66	Chromite
32-1-1	CR-67	Chromite
32-1-1	CR-68	Chromite
32-1-1	CR-69	Chromite
32-1-1	CR-70	Chromite
32-1-1	CR-71	Chromite
32-1-1	CR-72	Chromite
32-1-1	CR-73	Chromite
40-1-1	CR-74	Chromite
40-1-1	CR-75	Chromite
40-1-1	CR-76	Chromite
40-1-1	CR-77	Chromite
40-1-1	CR-78	Chromite
40-1-1	CR-79	Chromite
40-1-1	CR-80	Chromite
40-1-1	CR-81	Chromite
40-1-1	CR-82	Chromite
40-1-1	CR-83	Chromite
50-1-1	CR-84	Chromite
50-1-1	CR-85	Chromite
50-1-1	CR-86	Chromite
50-1-1	CR-87	Chromite
50-1-1	CR-88	Chromite
50-1-1	CR-89	Chromite
50-1-1	CR-90	Chromite
50-1-1	CR-91	Chromite
50-1-1	CR-92	Chromite
50-1-1	CR-93	Chromite
50-1-1	CR-94	Chromite
50-1-1	CR-95	Chromite

Sample #98-PJB-	Probe Number	Grain Type
50-1-1	CR-96	Chromite
50-1-1	CR-97	Chromite
50-1-1	CR-98	Chromite
50-1-1	CR-99	Chromite
50-1-1	CR-100	Chromite
50-1-1	CR-101	Chromite
50-1-1	CR-102	Chromite
50-1-1	CR-103	Chromite
50-1-1	CR-104	Chromite
61-1-1	CR-105	Chromite
61-1-1	CR-106	Chromite
61-1-1	CR-107	Chromite
61-1-1	CR-108	Chromite
61-1-1	CR-109	Chromite
61-1-1	CR-110	Chromite
61-1-1	CR-111	Chromite
61-1-1	CR-112	Chromite
61-1-1	CR-113	Chromite
61-1-1	CR-114	Chromite
61-1-1	CR-115	Chromite
61-1-1	CR-116	Chromite
61-1-1	CR-117	Chromite
61-1-1	CR-118	Chromite
61-1-1	CR-119	Chromite
62-2-1	CR-120	Chromite
62-2-1	CR-121	Chromite
62-2-1	CR-122	Chromite
62-2-1	CR-123	Chromite
62-2-1	CR-124	Chromite
62-2-1	CR-125	Chromite
62-2-1	CR-126	Chromite
62-2-1	CR-127	Chromite
62-2-1	CR-128	Chromite
62-2-1	CR-129	Chromite
73-1-1	CR-130	Chromite
73-1-1	CR-131	Chromite
73-1-1	CR-132	Chromite
73-1-1	CR-133	Chromite
73-1-1	CR-134	Chromite
73-1-1	CR-135	Chromite
73-1-1	CR-136	Chromite
73-1-1	CR-137	Chromite
73-1-1	CR-138	Chromite
73-1-1	CR-139	Chromite
85-1-1	CR-140	Chromite
85-1-1	CR-141	Chromite
85-1-1	CR-142	Chromite
85-1-1	CR-143	Chromite
85-1-1	CR-144	Chromite

Sample #98-PJB-	Probe Number	Grain Type
85-1-1	CR-145	Chromite
85-1-1	CR-146	Chromite
85-1-1	CR-147	Chromite
85-1-1	CR-148	Chromite
85-1-1	CR-149	Chromite
85-1-1	CR-150	Chromite
85-1-1	CR-151	Chromite
85-1-1	CR-152	Chromite
85-1-1	CR-153	Chromite
85-1-1	CR-154	Chromite
89-1-1	CR-155	Chromite
89-1-1	CR-156	Chromite
90-1-1	CR-157	Chromite
90-1-1	CR-158	Chromite
90-1-1	CR-159	Chromite
90-1-1	CR-160	Chromite
90-1-1	CR-161	Chromite
90-1-1	CR-162	Chromite
90-1-1	CR-163	Chromite
1-1-1	CR-164	Chromite
2-1-1	CR-165	Chromite
2-1-1	CR-166	Chromite
7-1-1	CR-167	Chromite
7-1-1	CR-168	Chromite
7-1-1	CR-169	Chromite
7-1-1	CR-170	Chromite
8-1-1	CR-171	Chromite
8-1-1	CR-172	Chromite
8-1-1	CR-173	Chromite
23-1-1	CR-174	Chromite
28-1-1	CR-175	Chromite
61-1-1	CR-176	Chromite
61-1-1	CR-177	Chromite
61-1-1	CR-178	Chromite
61-1-1	CR-179	Chromite
62-1-1	CR-180	Chromite
85-1-1	CR-181	Chromite
85-1-1	CR-182	Chromite
85-1-1	CR-183	Chromite

Sample #98-PJB-	Probe Number	Grain Type
1-1-1	IM-1	Ilmenite
1-1-1	IM-2	Ilmenite
1-1-1	IM-3	Ilmenite
2-1-1	IM-4	Ilmenite
2-1-1	IM-5	Ilmenite

1-1-1	GA-1	Gahnite
8-1-1	GA-2	Gahnite
23-1-1	GA-3	Gahnite
50-1-1	GA-4	Gahnite

Appendix F: Individual grain geochemistry.

Client	**Project 98052**		**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey		**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Garnet**		Data reviewed by Dave Crabtree
Sample	**Various**		
Job #	**98-0644**		
Analyst	**D. Crabtree**		
Analyst Approved	**March 31st, 1999**		

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total
Cr-pyrope Garnet												
GP-1	0.25-0.5	42.17	0.20	20.85	3.74	20.80	4.61	0.34	7.31	0.04	0.00	100.06
GP-2	0.25-0.5	41.51	0.51	19.01	5.43	20.78	5.27	0.27	6.78	0.04	0.00	99.60
GO-1	0.25-0.5	41.60	0.01	21.16	3.35	18.82	5.77	0.57	8.87	0.02	0.00	100.16
GO-2	0.25-0.5	41.95	0.67	21.02	2.05	20.73	4.96	0.29	8.23	0.06	0.00	99.96
OTHER GARNET												
Spessertine-Almandine												
SS-1	0.25-0.5	36.17	0.02	20.28	0.01	0.86	1.39	25.61	15.54	0.01	0.00	99.88
SS-2	0.25-0.5	36.38	0.02	19.92	0.00	2.16	0.87	17.19	23.16	0.03	0.00	99.74
SS-3	0.25-0.5	35.91	0.03	20.12	0.00	0.73	0.24	18.31	24.62	0.01	0.01	99.97
SS-4	0.25-0.5	36.16	0.04	20.21	0.00	0.90	0.75	16.27	26.06	0.02	0.01	100.41
SS-5	0.25-0.5	35.75	0.09	19.77	0.00	0.28	0.49	24.24	18.58	0.03	0.00	99.22
SS-6	0.25-0.5	36.07	0.12	19.83	0.01	0.76	0.67	26.86	15.10	0.03	0.00	99.44
SS-7	0.25-0.5	36.37	0.06	19.99	0.00	1.01	1.01	22.38	19.33	0.00	0.00	100.06
SS-8	0.25-0.5	36.20	0.03	20.16	0.00	1.12	1.89	25.02	14.99	0.01	0.01	99.42
SS-9	0.25-0.5	35.88	0.06	20.31	0.00	0.79	0.61	21.28	20.59	0.01	0.00	99.53
Almandine												
Al-1	0.25-0.5	38.38	0.10	21.25	0.04	4.52	11.03	1.28	23.93	0.00	0.00	100.53
Al-2	0.25-0.5	37.36	0.00	21.11	0.05	4.76	0.93	1.86	34.53	0.00	0.00	100.60
Al-3	0.25-0.5	37.87	0.04	20.96	0.00	3.97	9.33	0.72	27.26	0.01	0.00	100.16
Al-4	0.25-0.5	37.83	0.01	21.24	0.02	5.96	1.02	1.08	33.57	0.01	0.00	100.74
Al-5	0.25-0.5	38.41	0.01	21.73	0.08	7.94	1.19	0.77	30.64	0.01	0.00	100.78
Andradite-Uvarovite solid solution?												
AN-1	0.25-0.5	33.39	0.04	0.66	1.57	0.06	33.46	0.02	26.46	0.00	0.00	95.66
AN-1D	0.25-0.5	35.57	0.03	0.74	1.56	0.13	32.86	0.01	26.14	0.00	0.00	97.04
DC-9	0.25-0.5	35.86	0.72	0.03	9.03	0.28	32.86	0.02	18.89	0.01	0.00	97.70
DC-9D	0.25-0.5	32.45	0.60	0.01	7.61	0.21	34.72	0.03	17.70	0.00	0.00	93.33

All concentrations reported as wt%.

Client	**Project 98052**	**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey	**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Garnet**	Data reviewed by Dave Crabtree
Sample	**Various**	
Job #	**98-0644**	
Analyst	**D. Crabtree**	
Analyst Approved	**March 31st, 1999**	

QUALITY CONTROL

Analytical Conditions:	**20kV, 15nA, spot size 1-3 microns.**
Routine:	**Custom EDS/WDS garnet routine.**
Correction Procedure:	**ZAF-4**

Important note:

Due to variations in LOD and LOQ with sample matrix, these values are approximated in this report. LOD's for EDS data represent the best case scenario(i.e. no peak overlaps). Precision is best when data exceed the LOQ.The Geoscience Laboratories tracks long and short term precision on a variety of mineral standards. If you have any specific requirements please contact us.

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total
ampKNZ		40.30	4.87	14.94	0.02	12.40	9.81	0.08	10.87	2.54	2.05	97.88
ampKNZ		40.12	4.78	14.95	0.01	12.45	10.01	0.06	10.84	2.47	2.07	97.76
garKNZ		41.40	0.44	23.09	0.11	18.80	5.18	0.33	10.40	0.02	0.00	99.77
garKNZ		41.41	0.43	23.04	0.07	18.69	5.20	0.29	10.35	0.03	0.00	99.51
garRV3		42.01	0.01	19.59	5.68	22.81	2.50	0.35	6.33	0.01	0.00	99.30
garRV3		42.03	0.01	19.82	5.64	22.83	2.48	0.36	6.48	0.02	0.00	99.67
Standard		garKNZ	garKNZ	garKNZ	garRV3	garKNZ	garKNZ	garKNZ	garKNZ	ampKNZ	ampKNZ	
Average wt%		41.405	0.435	23.065	5.660	18.745	5.190	0.310	10.375	2.507	2.060	
Expected wt% *		41.460	0.433	23.140	5.770	18.810	5.134	0.320	10.500	2.600	2.100	
Trueness % rel.		-0.133	0.462	-0.324	-1.906	-0.346	1.091	-3.125	-1.190	-3.596	-1.905	
Mode		EDS	WDS	EDS	WDS	WDS	EDS	WDS	EDS	WDS	WDS	
XTAL		Si(Li)	PET	Si(Li)	LiF	PET	Si(Li)	LiF	Si(Li)	TAP	PET	
L.O.D. wt%		0.116	0.020	0.136	0.024	0.017	0.118	0.024	0.100	0.011	0.016	
L.O.Q. wt%		0.387	0.067	0.453	0.080	0.057	0.393	0.080	0.333	0.037	0.053	
Count time (seconds)		130	25	130	35	25	130	35	130	80	20	

All concentrations reported as wt%.

Client	**Project 98052**	**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey	**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Garnet**	Data reviewed by Dave Crabtree
Sample	**Various**	
Job #	**98-0644**	
Analyst	**D. Crabtree**	
Analyst Approved	**March 31st, 1999**	

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total

** Expected Values are from long term in-house charcterization of mineral standards.

QC note

1) None of the reported values for these mineral standards are certified:" trueness" is therefore based on available chemical data.
2) n.d. not determined for the specified mineral standard.
3) L.O.D. = Limit of Detection, precision ~ +/- 100%.
4) L.O.Q. = Limit of quantification (3.3 x L.O.D), precision ~ 10-30%.
5) Reported count times are for both peak and background measurements.
6) FeO* - total Iron expressed as FeO
7) D - duplicate analysis

Client	Project 98052		**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey		**ELECTRON MICROPROBE ANALYSIS**
Mineral	Chromite		Data reviewed by Dave Crabtree
Sample	Various		
Job #	98-0644		
Analyst	D. Crabtree		
Analyst Approved	March 31st, 1999		

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-1	0.25-0.5	0.02	0.40	0.00	13.85	50.72	0.22	7.34	0.33	26.86	0.14	0.13	100.00	4.00	23.26	100.40
CR-2	0.25-0.5	0.01	1.03	0.06	12.46	47.20	0.34	9.24	0.29	28.40	0.12	0.11	99.25	8.43	20.82	100.10
CR-3	0.25-0.5	0.08	0.30	0.02	12.92	50.70	0.14	3.66	0.55	30.91	0.15	0.39	99.81	3.17	28.05	100.13
CR-4	0.25-0.5	0.01	0.64	0.00	13.80	50.86	0.18	10.17	0.25	23.73	0.10	0.10	99.82	5.08	19.16	100.33
CR-5	0.25-0.5	0.00	0.32	0.00	11.52	53.42	0.23	9.47	0.28	23.94	0.13	0.09	99.40	4.97	19.47	99.89
CR-6	0.25-0.5	0.07	0.39	0.02	13.57	53.07	0.25	12.78	0.21	19.26	0.16	0.02	99.80	4.55	15.16	100.25
CR-7	0.25-0.5	0.02	0.87	0.00	13.54	50.88	0.33	10.43	0.21	22.98	0.08	0.13	99.48	4.35	19.07	99.92
CR-8	0.25-0.5	0.00	0.37	0.00	11.53	53.09	0.21	9.92	0.28	24.24	0.11	0.07	99.82	5.84	18.99	100.41
CR-9	0.25-0.5	0.02	0.72	0.00	16.58	47.96	0.33	11.90	0.27	21.66	0.16	0.12	99.72	5.03	17.14	100.22
CR-10	0.25-0.5	0.00	0.98	0.00	10.07	52.23	0.21	8.23	0.31	28.12	0.15	0.13	100.44	6.83	21.97	101.13
CR-11	0.25-0.5	0.00	0.70	0.01	13.19	51.45	0.31	9.92	0.23	23.81	0.11	0.08	99.80	4.55	19.71	100.26
CR-13	0.25-0.5	0.07	0.29	0.00	11.77	55.87	0.18	10.84	0.22	20.55	0.09	0.09	99.97	3.23	17.65	100.29
CR-14	0.25-0.5	0.03	0.38	0.02	11.38	54.66	0.22	10.21	0.27	23.08	0.11	0.06	100.44	4.77	18.79	100.92
CR-15	0.25-0.5	0.00	0.45	0.01	12.32	52.21	0.25	7.34	0.47	26.42	0.08	0.24	99.79	3.98	22.84	100.19
CR-16	0.25-0.5	0.00	0.72	0.02	13.85	48.60	0.19	9.21	0.28	26.52	0.08	0.11	99.58	6.50	20.67	100.23
CR-17	0.25-0.5	0.00	0.66	0.00	15.29	49.22	0.14	8.13	0.38	26.20	0.13	0.08	100.23	4.19	22.43	100.64
CR-18	0.25-0.5	0.00	0.70	0.04	10.92	52.77	0.25	6.27	0.39	27.96	0.11	0.22	99.64	3.84	24.51	100.03
CR-19	0.25-0.5	0.07	0.39	0.00	12.81	54.29	0.24	11.63	0.25	20.42	0.12	0.05	100.27	3.96	16.86	100.66
CR-20	0.25-0.5	0.00	0.53	0.04	11.94	52.33	0.34	10.08	0.29	24.29	0.12	0.09	100.06	5.64	19.22	100.63
CR-21	0.25-0.5	0.06	0.38	0.06	13.59	51.53	0.18	9.57	0.27	23.50	0.12	0.14	99.40	4.23	19.70	99.83
CR-22	0.25-0.5	0.00	2.20	0.04	12.00	48.26	0.31	6.04	0.41	30.16	0.21	0.32	99.95	4.17	26.40	100.37
CR-23	0.25-0.5	0.01	0.78	0.00	12.77	49.77	0.34	7.75	0.39	27.60	0.14	0.11	99.66	5.32	22.82	100.19
CR-24	0.25-0.5	0.10	0.38	0.00	11.87	52.45	0.24	9.79	0.27	24.36	0.13	0.08	99.66	5.59	19.32	100.22
CR-25	0.25-0.5	0.09	0.33	0.02	13.26	53.58	0.22	12.39	0.22	19.60	0.16	0.05	99.92	4.43	15.62	100.36
CR-26	0.25-0.5	0.05	0.37	0.04	12.00	52.73	0.32	9.00	0.25	24.95	0.13	0.12	99.96	4.70	20.72	100.43
CR-27	0.25-0.5	0.06	0.34	0.00	13.23	56.17	0.18	13.41	0.18	16.29	0.19	0.09	100.13	2.59	13.95	100.39
CR-28	0.25-0.5	0.00	1.19	0.04	12.87	48.14	0.31	6.57	0.40	29.90	0.13	0.15	99.69	5.46	24.99	100.24
CR-29	0.25-0.5	0.03	0.33	0.05	11.35	53.29	0.24	7.61	0.45	26.39	0.13	0.03	99.89	4.42	22.41	100.33
CR-30	0.25-0.5	0.01	0.55	0.04	13.42	51.60	0.26	11.18	0.22	22.30	0.14	0.00	99.73	5.13	17.68	100.24
CR-31	0.25-0.5	0.01	1.24	0.04	9.92	51.81	0.36	8.30	0.27	27.21	0.16	0.14	99.43	5.75	22.03	100.00
CR-32	0.25-0.5	0.00	0.59	0.01	12.89	52.66	0.28	10.51	0.24	22.88	0.12	0.09	100.30	4.61	18.74	100.76
CR-33	0.25-0.5	0.12	0.60	0.07	31.96	34.33	0.08	17.48	0.16	15.19	0.18	0.06	100.23	4.65	11.01	100.69
CR-34	0.25-0.5	0.09	0.31	0.06	13.29	55.69	0.17	14.01	0.12	16.05	0.18	0.01	99.99	3.16	13.21	100.31
CR-35	0.25-0.5	0.01	1.00	0.00	13.63	49.99	0.31	11.08	0.21	23.11	0.12	0.10	99.56	5.44	18.21	100.10
CR-36	0.25-0.5	0.00	0.85	0.00	10.95	51.60	0.27	8.78	0.29	26.85	0.08	0.12	99.78	6.36	21.12	100.42
CR-37	0.25-0.5	0.01	0.96	0.01	12.44	45.71	0.20	5.46	0.45	34.11	0.08	0.26	99.71	8.81	26.19	100.59
CR-38	0.25-0.5	0.00	1.10	0.05	11.02	46.50	0.38	4.13	0.48	35.33	0.07	0.29	99.35	7.87	28.25	100.14

All concentrations reported as wt%.

Client	Project 98052
	Ontario Geological Survey
Mineral	Chromite
Sample	Various
Job #	98-0644
Analyst	D. Crabtree
Analyst Approved	March 31st, 1999

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-39	0.25-0.5	0.03	0.38	0.05	11.70	54.04	0.27	10.24	0.27	23.06	0.13	0.11	100.28	4.75	18.79	100.75
CR-40	0.25-0.5	0.00	1.20	0.00	14.55	46.14	0.27	6.65	0.44	30.21	0.16	0.14	99.77	5.79	25.00	100.35
CR-41	0.25-0.5	0.06	0.33	0.06	14.01	50.76	0.12	7.21	0.23	26.54	0.12	0.04	99.48	3.52	23.37	99.83
CR-42	0.25-0.5	0.00	0.89	0.00	13.47	46.23	0.26	6.62	0.40	29.73	0.15	0.15	99.90	5.63	24.66	100.46
CR-43	0.25-0.5	0.00	0.45	0.01	12.50	48.50	0.31	7.81	0.29	28.87	0.18	0.18	99.09	7.41	22.21	99.84
CR-44	0.25-0.5	0.10	1.03	0.00	25.35	38.39	0.08	15.57	0.16	18.38	0.22	0.00	99.28	6.07	12.92	99.89
CR-45	0.25-0.5	0.07	0.26	0.00	12.96	52.55	0.20	10.47	0.29	22.69	0.08	0.16	99.73	4.96	18.23	100.22
CR-46	0.25-0.5	0.04	0.39	0.00	11.04	51.11	0.31	7.14	0.28	28.64	0.10	0.12	99.17	6.13	23.12	99.79
CR-48	0.25-0.5	0.05	0.37	0.00	12.55	53.39	0.26	10.96	0.23	22.03	0.12	0.05	100.01	4.71	17.79	100.49
CR-49	0.25-0.5	0.00	0.82	0.03	13.04	51.81	0.28	9.39	0.36	23.85	0.08	0.12	99.79	3.82	20.42	100.17
CR-50	0.25-0.5	0.00	0.32	0.02	11.74	54.10	0.26	11.00	0.23	21.84	0.18	0.10	99.79	5.02	17.33	100.29
CR-52	0.25-0.5	0.00	0.73	0.00	14.41	52.21	0.19	12.22	0.18	19.76	0.13	0.08	99.91	3.90	16.25	100.30
CR-53	0.25-0.5	0.00	1.00	0.00	12.15	50.82	0.29	6.55	0.46	28.25	0.11	0.11	99.73	4.01	24.65	100.14
CR-54	0.25-0.5	0.10	0.30	0.00	12.26	55.77	0.11	11.57	0.18	19.44	0.13	0.09	99.96	3.23	16.53	100.28
CR-55	0.25-0.5	0.00	0.41	0.05	15.08	49.36	0.25	9.84	0.28	23.87	0.13	0.06	99.34	4.72	19.62	99.81
CR-56	0.25-0.5	0.00	0.75	0.00	14.61	50.08	0.35	11.54	0.24	21.71	0.06	0.05	99.39	4.70	17.49	99.86
CR-57	0.25-0.5	0.00	1.17	0.00	12.49	46.07	0.46	5.21	0.50	33.20	0.15	0.50	99.75	7.13	26.79	100.47
CR-58	0.25-0.5	0.03	0.72	0.00	13.87	48.04	0.36	9.16	0.29	27.18	0.05	0.13	99.83	6.77	21.09	100.51
CR-59	0.25-0.5	0.00	0.43	0.00	14.88	51.23	0.26	9.00	0.40	23.42	0.12	0.12	99.86	2.87	20.83	100.15
CR-60	0.25-0.5	0.00	2.42	0.00	11.37	47.95	0.56	9.10	0.31	28.47	0.16	0.22	100.56	6.49	22.63	101.21
CR-61	0.25-0.5	0.02	0.54	0.03	14.87	52.39	0.23	11.68	0.23	20.10	0.12	0.06	100.26	3.23	17.19	100.59
CR-62	0.25-0.5	0.03	0.40	0.00	11.78	52.57	0.30	9.88	0.25	24.16	0.11	0.09	99.55	5.51	19.20	100.10
CR-63	0.25-0.5	0.10	0.31	0.00	13.48	55.82	0.18	14.35	0.17	15.36	0.21	0.00	99.98	3.08	12.59	100.29
CR-64	0.25-0.5	0.02	0.60	0.03	15.58	49.81	0.17	9.60	0.39	23.35	0.11	0.10	99.76	3.61	20.10	100.12
CR-65	0.25-0.5	0.04	0.33	0.00	12.38	53.91	0.24	10.88	0.25	20.82	0.12	0.09	99.05	3.80	17.40	99.43
CR-66	0.25-0.5	0.04	0.47	0.00	13.58	54.76	0.27	11.36	0.21	18.79	0.12	0.08	99.66	1.68	17.27	99.83
CR-67	0.25-0.5	0.00	0.95	0.00	13.27	48.15	0.27	6.35	0.45	29.76	0.10	0.32	99.62	5.44	24.86	100.16
CR-68	0.25-0.5	0.01	0.70	0.00	14.07	45.55	0.25	2.49	0.25	35.91	0.13	0.17	99.52	5.51	30.95	100.08
CR-69	0.25-0.5	0.06	0.48	0.00	14.33	53.51	0.15	11.31	0.25	19.73	0.12	0.08	100.02	2.62	17.37	100.28
CR-70	0.25-0.5	0.00	0.52	0.00	13.98	52.59	0.28	10.09	0.23	22.18	0.13	0.18	100.17	3.16	19.34	100.49
CR-71	0.25-0.5	0.00	0.38	0.02	13.39	50.79	0.21	7.92	0.41	26.73	0.14	0.20	100.19	5.07	22.17	100.70
CR-72	0.25-0.5	0.02	0.81	0.03	12.77	49.95	0.30	9.97	0.26	25.13	0.08	0.07	99.38	6.17	19.58	100.00
CR-73	0.25-0.5	0.00	2.38	0.00	12.15	46.39	0.40	9.53	0.31	27.41	0.20	0.13	98.91	6.76	21.33	99.59
CR-74	0.25-0.5	0.10	0.30	0.00	12.24	54.88	0.15	11.15	0.22	20.06	0.13	0.05	99.29	3.38	17.02	99.62
CR-75	0.25-0.5	0.00	0.54	0.00	13.94	53.40	0.23	10.78	0.24	20.66	0.12	0.07	99.98	2.68	18.25	100.25
CR-76	0.25-0.5	0.00	0.86	0.00	10.26	50.47	0.31	8.24	0.31	28.73	0.12	0.05	99.35	7.71	21.79	100.12
CR-77	0.25-0.5															

* All concentrations reported as wt%.

Client	Project 98052
	Ontario Geological Survey
Mineral	Chromite
Sample	Various
Job #	98-0644
Analyst	D. Crabtree
Analyst Approved	March 31st, 1999

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-78	0.25-0.5	0.01	1.33	0.00	12.92	47.60	0.32	5.94	0.41	30.79	0.17	0.27	99.75	5.40	25.94	100.29
CR-79	0.25-0.5	0.05	0.79	0.01	14.48	49.48	0.27	10.28	0.31	23.61	0.13	0.13	99.54	4.85	19.25	100.03
CR-80	0.25-0.5	0.06	0.35	0.00	10.51	56.48	0.13	10.15	0.22	21.66	0.10	0.10	99.78	3.63	18.39	100.15
CR-81	0.25-0.5	0.03	0.78	0.00	13.14	51.26	0.30	8.67	0.33	24.68	0.15	0.15	99.49	3.68	21.37	99.86
CR-82	0.25-0.5	0.00	2.18	0.02	10.74	49.77	0.44	9.53	0.36	26.42	0.05	0.07	99.57	5.63	21.35	100.13
CR-83	0.25-0.5	0.00	0.38	0.00	10.86	52.85	0.24	8.26	0.35	26.69	0.11	0.10	99.83	5.91	21.37	100.42
CR-84	0.25-0.5	0.01	0.28	0.02	16.32	48.94	0.22	11.33	0.25	22.34	0.09	0.05	99.86	5.25	17.62	100.39
CR-85	0.25-0.5	0.08	0.33	0.02	12.35	53.96	0.22	10.68	0.23	21.63	0.08	0.10	99.69	4.00	18.03	100.09
CR-86	0.25-0.5	0.04	1.30	0.00	15.03	47.34	0.36	11.22	0.26	23.90	0.18	0.09	99.73	5.94	18.55	100.33
CR-87	0.25-0.5	0.00	0.46	0.00	15.91	48.42	0.30	11.57	0.18	22.41	0.16	0.07	99.48	5.69	17.30	100.05
CR-88	0.25-0.5	0.03	0.43	0.00	13.89	51.72	0.15	7.99	0.29	25.22	0.07	0.11	99.89	3.28	22.27	100.22
CR-89	0.25-0.5	0.00	0.47	0.00	17.48	48.94	0.28	12.90	0.19	19.42	0.17	0.08	99.94	4.27	15.58	100.36
CR-90	0.25-0.5	0.03	0.43	0.00	13.47	51.57	0.23	10.96	0.23	22.32	0.16	0.09	99.51	5.15	17.69	100.02
CR-91	0.25-0.5	0.00	0.60	0.01	10.67	50.19	0.26	3.83	1.05	32.58	0.08	0.27	99.54	5.72	27.43	100.11
CR-92	0.25-0.5	0.07	0.40	0.00	13.21	52.53	0.26	9.74	0.24	23.47	0.07	0.12	100.11	4.08	19.80	100.52
CR-93	0.25-0.5	0.02	0.22	0.00	17.13	45.45	0.21	7.71	0.55	28.14	0.12	0.22	99.76	6.04	22.70	100.37
CR-94	0.25-0.5	0.00	2.20	0.00	12.56	45.90	0.46	9.29	0.31	28.78	0.15	0.13	99.77	7.50	22.03	100.52
CR-95	0.25-0.5	0.01	1.01	0.02	15.49	47.56	0.35	9.92	0.24	24.78	0.12	0.08	99.58	4.92	20.35	100.08
CR-96	0.25-0.5	0.00	0.71	0.05	11.93	49.42	0.28	5.12	0.50	31.14	0.07	0.28	99.52	5.30	26.37	100.05
CR-97	0.25-0.5	0.00	2.44	0.02	11.76	45.26	0.47	8.40	0.23	30.80	0.14	0.13	99.65	8.05	23.56	100.45
CR-98	0.25-0.5	0.00	0.85	0.00	10.23	49.52	0.29	8.11	0.31	30.15	0.15	0.16	99.77	9.08	21.98	100.68
CR-99	0.25-0.5	0.00	0.88	0.01	15.16	49.13	0.23	7.58	0.38	26.93	0.15	0.19	100.63	3.69	23.61	101.00
CR-100	0.25-0.5	0.05	0.38	0.00	12.58	54.39	0.24	11.82	0.18	19.97	0.20	0.09	99.91	4.02	16.35	100.31
CR-101	0.25-0.5	0.01	0.49	0.00	12.80	51.02	0.32	9.20	0.31	25.58	0.04	0.08	99.86	5.53	20.61	100.41
CR-102	0.25-0.5	0.02	0.46	0.03	15.22	49.67	0.41	11.54	0.26	21.71	0.14	0.11	99.57	4.81	17.38	100.05
CR-103	0.25-0.5	0.01	0.70	0.04	13.37	49.93	0.32	9.89	0.31	24.69	0.14	0.08	99.47	5.61	19.63	100.03
CR-104	0.25-0.5	0.02	0.26	0.00	16.62	46.38	0.26	8.75	0.35	27.04	0.10	0.09	99.87	6.15	21.51	100.49
CR-105	0.25-0.5	0.05	0.37	0.01	12.80	51.99	0.24	9.61	0.26	24.36	0.10	0.10	99.86	5.10	19.77	100.38
CR-106	0.25-0.5	0.09	0.27	0.02	13.27	55.31	0.14	12.82	0.18	17.73	0.12	0.06	100.02	3.18	14.87	100.34
CR-107	0.25-0.5	0.02	0.61	0.00	11.65	52.51	0.32	8.29	0.36	26.21	0.15	0.06	100.18	4.82	21.87	100.66
CR-108	0.25-0.5	0.09	0.27	0.04	13.06	56.26	0.11	13.90	0.17	15.51	0.20	0.02	99.65	2.80	12.99	99.93
CR-109	0.25-0.5	0.02	0.80	0.05	12.25	50.01	0.32	8.34	0.29	27.25	0.11	0.15	99.59	5.85	21.98	100.18
CR-110	0.25-0.5	0.00	0.44	0.02	10.93	54.17	0.18	10.09	0.29	23.69	0.14	0.13	100.07	5.63	18.62	100.64
CR-111	0.25-0.5	0.03	0.56	0.00	12.88	51.86	0.22	7.38	0.35	26.25	0.09	0.22	99.83	3.52	23.07	100.18
CR-112	0.25-0.5	0.06	0.34	0.00	11.83	53.80	0.16	10.13	0.31	22.77	0.13	0.10	99.63	4.73	18.52	100.11
CR-113	0.25-0.5	0.08	0.29	0.05	12.72	55.45	0.15	12.53	0.19	17.77	0.12	0.10	99.46	3.03	15.04	99.76
CR-114	0.25-0.5	0.02	0.56	0.00	12.85	52.57	0.22	11.38	0.25	21.49	0.11	0.09	99.55	4.91	17.07	100.04

All concentrations reported as wt%.

Client	Project 98052
	Ontario Geological Survey
Mineral	Chromite
Sample	Various
Job #	98-0644
Analyst	D. Crabtree
Analyst Approved	March 31st, 1999

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-115	0.25-0.5	0.00	0.64	0.00	13.12	49.92	0.30	6.47	0.45	28.44	0.11	0.18	99.64	4.36	24.52	100.08
CR-116	0.25-0.5	0.07	0.37	0.00	13.75	52.89	0.16	11.96	0.24	19.88	0.08	0.03	99.42	4.14	16.15	99.83
CR-117	0.25-0.5	0.00	0.97	0.01	10.86	51.83	0.34	9.32	0.25	26.03	0.08	0.07	99.77	6.07	20.57	100.37
CR-118	0.25-0.5	0.00	0.60	0.08	12.59	53.11	0.27	11.05	0.27	21.52	0.11	0.08	99.69	4.22	17.72	100.11
CR-119	0.25-0.5	0.01	0.35	0.07	11.50	54.07	0.17	9.10	0.28	24.00	0.08	0.10	99.73	4.27	20.16	100.16
CR-120	0.25-0.5	0.02	1.13	0.00	12.74	49.06	0.30	6.19	0.42	29.21	0.14	0.15	99.36	4.33	25.31	99.79
CR-121	0.25-0.5	0.08	0.27	0.04	12.69	55.58	0.13	11.46	0.52	18.81	0.15	0.08	99.81	2.71	16.38	100.08
CR-122	0.25-0.5	0.03	0.52	0.00	12.84	50.13	0.27	6.68	0.43	27.95	0.05	0.20	99.12	4.45	23.95	99.56
CR-123	0.25-0.5	0.04	0.46	0.04	11.94	50.28	0.25	9.24	0.30	26.81	0.07	0.07	99.50	7.28	20.26	100.23
CR-124	0.25-0.5	0.00	1.31	0.00	13.57	49.12	0.28	6.91	0.41	28.20	0.12	0.13	100.04	3.89	24.70	100.43
CR-125	0.25-0.5	0.09	0.34	0.02	14.37	53.39	0.24	12.57	0.21	18.44	0.20	0.02	99.89	3.25	15.52	100.21
CR-126	0.25-0.5	0.02	0.83	0.01	13.68	49.10	0.24	6.48	0.45	28.19	0.09	0.28	99.38	4.04	24.56	99.78
CR-127	0.25-0.5	0.00	1.00	0.00	12.64	47.62	0.36	5.39	0.45	31.80	0.10	0.39	99.75	5.99	26.41	100.35
CR-128	0.25-0.5	0.00	0.42	0.00	11.41	53.49	0.27	10.04	0.26	23.72	0.15	0.11	99.86	5.39	18.87	100.40
CR-129	0.25-0.5	0.07	0.89	0.04	10.30	49.74	0.37	4.18	0.53	33.17	0.08	0.39	99.76	5.91	27.86	100.35
CR-130	0.25-0.5	0.00	0.68	0.05	12.77	48.82	0.24	5.93	0.42	30.21	0.11	0.22	99.44	5.51	25.25	99.99
CR-131	0.25-0.5	0.04	0.70	0.00	13.71	51.72	0.27	7.19	0.36	27.42	0.10	0.14	101.64	3.43	24.34	101.99
CR-132	0.25-0.5	0.01	1.92	0.02	11.27	44.92	0.33	3.26	0.48	36.83	0.14	0.20	99.40	7.28	30.28	100.12
CR-133	0.25-0.5	0.01	0.69	0.00	13.51	50.61	0.25	7.72	0.42	26.57	0.11	0.15	100.04	4.14	22.84	100.46
CR-134	0.25-0.5	0.00	0.40	0.06	11.15	53.05	0.28	9.84	0.26	24.24	0.06	0.06	99.39	5.64	19.17	99.96
CR-135	0.25-0.5	0.07	0.39	0.02	12.37	52.10	0.28	9.09	0.30	24.96	0.09	0.08	99.77	4.88	20.56	100.26
CR-136	0.25-0.5	0.05	0.30	0.00	11.78	53.93	0.17	9.66	0.30	23.43	0.11	0.11	99.85	4.60	19.29	100.31
CR-137	0.25-0.5	0.00	1.32	0.00	10.13	50.92	0.27	7.88	0.30	28.35	0.05	0.09	99.32	6.30	22.69	99.95
CR-138	0.25-0.5	0.01	1.47	0.00	13.78	43.66	0.37	4.81	0.43	34.66	0.17	0.19	99.54	7.38	28.02	100.28
CR-139	0.25-0.5	0.02	0.87	0.00	14.34	48.45	0.36	6.88	0.37	28.52	0.09	0.34	100.24	4.40	24.56	100.68
CR-140	0.25-0.5	0.00	0.80	0.00	13.49	44.80	0.42	4.52	0.49	34.87	0.17	0.34	99.90	7.87	27.79	100.69
CR-141	0.25-0.5	0.07	0.34	0.00	12.63	54.47	0.13	10.80	0.22	20.97	0.12	0.06	99.82	3.58	17.75	100.18
CR-142	0.25-0.5	0.02	0.39	0.00	11.81	53.09	0.24	9.48	0.26	24.24	0.11	0.12	99.77	5.04	19.71	100.27
CR-143	0.25-0.5	0.00	0.96	0.00	13.17	47.76	0.32	5.54	0.42	30.95	0.10	0.22	99.47	5.21	26.26	99.99
CR-144	0.25-0.5	0.01	1.56	0.00	11.63	47.79	0.33	4.57	0.39	33.44	0.10	0.25	100.07	5.74	28.27	100.65
CR-145	0.25-0.5	0.06	0.36	0.02	12.31	53.77	0.24	10.61	0.26	21.50	0.13	0.04	99.28	3.90	17.99	99.68
CR-146	0.25-0.5	0.07	0.32	0.00	12.51	56.55	0.07	12.98	0.23	17.23	0.17	0.07	100.22	3.22	14.34	100.54
CR-147	0.25-0.5	0.01	0.18	0.04	17.58	46.87	0.33	11.09	0.25	23.00	0.21	0.06	99.61	5.46	18.08	100.16
CR-148	0.25-0.5	0.01	0.39	0.00	11.01	54.71	0.25	8.06	0.32	24.74	0.10	0.06	99.66	3.37	21.71	100.00
CR-149	0.25-0.5	0.00	0.58	0.00	12.81	46.77	0.39	6.57	0.51	31.93	0.08	0.32	99.95	8.35	24.41	100.78
CR-150	0.25-0.5	0.05	0.50	0.00	13.11	53.36	0.21	10.66	0.26	21.47	0.13	0.13	99.88	3.63	18.20	100.24
CR-151	0.25-0.5	0.01	0.34	0.00	15.01	53.95	0.20	13.15	0.20	16.65	0.09	0.11	99.71	2.37	14.52	99.95

All concentrations reported as wt%.

Client	**Project 98052**
	Ontario Geological Survey
Mineral	**Chromite**
Sample	**Various**
Job #	**98-0644**
Analyst	**D. Crabtree**
Analyst Approved	**March 31st, 1999**

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-152	0.25-0.5	0.01	0.83	0.00	14.18	50.20	0.31	10.23	0.27	23.52	0.10	0.10	99.75	4.52	19.45	100.20
CR-153	0.25-0.5	0.06	0.29	0.03	13.64	54.07	0.15	11.33	0.25	20.02	0.15	0.09	100.08	3.24	17.10	100.41
CR-154	0.25-0.5	0.04	0.53	0.03	11.18	52.21	0.28	8.91	0.31	26.18	0.07	0.07	99.81	5.99	20.79	100.41
CR-155	0.25-0.5	0.00	0.99	0.04	12.20	49.62	0.27	5.91	0.40	29.89	0.11	0.11	99.55	4.72	25.65	100.02
CR-156	0.25-0.5	0.05	0.43	0.00	13.30	55.44	0.19	11.97	0.28	17.80	0.07	0.10	99.62	1.90	16.09	99.81
CR-157	0.25-0.5	0.00	0.57	0.02	15.28	47.46	0.33	6.96	0.43	28.80	0.15	0.28	100.27	5.07	24.24	100.78
CR-158	0.25-0.5	0.01	0.40	0.03	9.51	55.96	0.15	6.91	0.45	26.64	0.07	0.06	100.17	3.82	23.20	100.56
CR-159	0.25-0.5	0.02	0.42	0.00	11.20	48.26	0.27	1.40	0.71	37.23	0.03	0.28	99.83	6.28	31.58	100.46
CR-160	0.25-0.5	0.00	1.43	0.05	10.85	49.95	0.32	8.56	0.39	27.67	0.15	0.06	99.44	6.45	21.87	100.09
CR-161	0.25-0.5	0.11	0.34	0.02	11.54	52.49	0.15	8.32	0.33	25.96	0.13	0.09	99.50	5.21	21.27	100.03
CR-162	0.25-0.5	0.02	0.44	0.02	10.89	53.60	0.28	6.91	0.41	27.46	0.13	0.27	100.42	4.41	23.49	100.86
CR-163	0.25-0.5	0.18	0.50	0.03	11.48	49.18	0.22	6.27	0.48	31.11	0.09	0.19	99.73	7.20	24.63	100.45
CR-164	0.25-0.5	0.07	0.26	0.10	11.93	52.19	0.14	4.53	0.17	29.61	0.16	0.39	99.54	3.00	26.91	99.84
CR-165	0.25-0.5	0.01	0.86	0.00	13.79	51.69	0.26	9.46	0.32	23.54	0.15	0.04	100.12	3.31	20.56	100.45
CR-166	0.25-0.5	0.00	0.65	0.00	13.14	51.28	0.30	8.31	0.35	25.14	0.13	0.09	99.39	3.71	21.80	99.76
CR-167	0.25-0.5	0.05	0.32	0.02	11.72	54.46	0.15	10.76	0.27	21.75	0.13	0.08	99.71	4.62	17.59	100.17
CR-168	0.25-0.5	0.17	0.58	0.00	13.88	52.83	0.12	10.86	0.22	20.61	0.12	0.12	99.51	2.86	18.03	99.79
CR-169	0.25-0.5	0.01	0.69	0.00	12.61	49.23	0.30	5.91	0.41	30.09	0.07	0.44	99.77	5.37	25.26	100.31
CR-170	0.25-0.5	0.00	0.48	0.00	12.99	51.30	0.22	6.94	0.45	27.21	0.14	0.34	100.09	4.15	23.48	100.51
CR-172	0.25-0.5	0.08	0.32	0.04	11.73	52.59	0.24	6.49	0.32	27.84	0.12	0.14	99.93	3.95	24.28	100.32
CR-173	0.25-0.5	0.00	0.55	0.01	11.68	53.52	0.32	9.07	0.30	23.68	0.13	0.04	99.29	3.63	20.42	99.66
CR-174	0.25-0.5	0.01	0.90	0.01	11.96	49.63	0.26	5.47	0.55	30.66	0.07	0.25	99.77	5.17	26.01	100.29
CR-175	0.25-0.5	0.06	0.37	0.00	14.84	52.81	0.30	12.19	0.22	19.20	0.15	0.06	100.21	3.18	16.34	100.53
CR-176	0.25-0.5	0.02	0.40	0.01	13.22	52.74	0.23	8.72	0.37	23.98	0.14	0.08	99.92	3.30	21.02	100.25
CR-177	0.25-0.5	0.25	0.35	0.04	11.53	51.15	0.13	6.19	0.42	28.21	0.12	0.22	98.60	4.45	24.21	99.05
CR-178	0.25-0.5	0.02	0.78	0.00	13.42	50.38	0.27	7.53	0.35	26.58	0.14	0.13	99.61	3.82	23.15	99.99
CR-179	0.25-0.5	0.00	0.65	0.05	13.58	52.54	0.16	9.64	0.30	22.43	0.15	0.10	99.60	2.99	19.74	99.90
CR-180	0.25-0.5	0.00	0.30	0.00	17.90	44.95	0.18	10.19	0.57	25.09	0.14	0.16	99.48	6.84	18.93	100.16
CR-182	0.25-0.5	0.01	0.52	0.00	11.75	53.09	0.21	10.01	0.28	23.25	0.11	0.08	99.32	4.93	18.82	99.81
CR-183	0.25-0.5	0.00	0.48	0.00	12.63	53.42	0.26	8.93	0.47	23.13	0.11	0.15	99.57	2.98	20.45	99.87
Fe-oxide																
CR-77	0.25-0.5															

All concentrations reported as wt%.

Client	**Project 98052**		**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey		**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Chromite**		Data reviewed by Dave Crabtree
Sample	**Various**		
Job #	**98-0644**		
Analyst	**D. Crabtree**		
Analyst Approved	**March 31st, 1999**		

QUALITY CONTROL

Analytical Conditions:	**20kV, 15nA, spot size 1-3 microns.**
Routine:	**Custom EDS/WDS chromite routine.**
Correction Procedure:	**ZAF-4 with off-line correction for Tikb-Vka (LiF).**

Important note:

Due to variations in LOD and LOQ with sample matrix, these values are approximated in this report. LOD's for EDS data represent the best case scenario (i.e. no peak overlaps)
Precision is best when data exceed the LOQ.The Geoscience Laboratories tracks long and short term precision on a variety of mineral standards.
If you have any specific requirements please contact us.

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
chrRV1		0.03	0.42	0.00	8.86	62.93	0.22	13.51	0.20	13.31	0.05	0.06	99.59			
chrRV1		0.04	0.41	0.00	8.90	62.97	0.17	13.57	0.16	13.40	0.11	0.09	99.82			
chrRV1		0.05	0.40	0.00	8.92	63.06	0.17	13.53	0.20	13.18	0.08	0.08	99.67			
chrRV1		0.04	0.39	0.00	8.85	62.99	0.13	13.59	0.19	13.33	0.07	0.13	99.71			
gahBRZ		0.05	0.00	0.01	54.71	0.02	0.00	0.07	0.33	1.92	0.01	41.40	98.52			
gahBRZ		0.04	0.00	0.00	55.16	0.00	0.07	0.18	0.35	1.99	0.03	41.69	99.51			
gahBRZ		0.02	0.01	0.02	54.81	0.00	0.00	0.13	0.38	2.00	0.00	41.97	99.34			
gahBRZ		0.04	0.00	0.03	54.91	0.00	0.00	0.15	0.30	1.99	0.01	41.82	99.25			
ilmMSU		0.02	46.82	1.03	0.12	0.04	0.05	0.35	4.68	45.99	0.01	0.12	99.23			
ilmMSU		0.00	45.38	1.10	0.16	0.01	0.08	0.38	4.37	47.30	0.00	0.08	98.84			
ilmMSU		0.04	46.19	0.92	0.12	0.00	0.06	0.31	4.50	46.57	0.00	0.11	98.82			
ilmMSU		0.03	46.54	0.95	0.16	0.03	0.06	0.31	4.32	46.52	0.00	0.05	98.97			
Standard		chrRV1	ilmMSU	ilmMSU	chrRV1	chrRV1	chrRV1	chrRV1	ilmMSU	ilmMSU	chrRV1	gahBRZ				
Average wt%		L.O.D.	46.233	1.000	8.883	62.988	L.O.D.	13.550	4.468	46.595	L.O.D.	41.720				
Expected wt% *		L.O.D.	46.756	0.980	8.900	62.850	L.O.D.	13.840	4.600	46.419	L.O.D.	41.870				
Trueness % rel.			-1.120	2.041	-0.197	0.219		-2.095	-2.880	0.379		-0.358				
Mode		WDS	WDS	WDS	EDS	EDS	WDS	EDS	WDS	EDS	WDS	WDS				
XTAL		TAP	PET	PET	Si(Li)	Si(Li)	LiF	Si(Li)	LiF	Si(Li)	LiF	LiF				
L.O.D. wt%		0.021	0.019	0.056	0.136	0.095	0.056	0.118	0.046	0.100	0.041	0.054				
L.O.Q. wt%		0.070	0.063	0.187	0.453	0.317	0.187	0.393	0.153	0.333	0.137	0.180				
Count time (seconds)		40	40	40	130	130	20	130	20	130	20	20				

** Expected Values are from long term in-house charcterization of mineral standards.

QC note

All concentrations reported as wt%.

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Client	Project 98052
	Ontario Geological Survey
Mineral	Chromite
Sample	Various
Job #	98-0644
Analyst	D. Crabtree
Analyst Approved	March 31st, 1999

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total

1) None of the reported values for these mineral standards are certified:" trueness" is therefore based on available chemical data.
2) n.d. not determined for the specified mineral standard.
3) L.O.D. = Limit of Detection, precision ~ +/- 100%.
4) L.O.Q. = Limit of quantification (3.3 x L.O.D), precision ~ 10-30%.
5) Reported count times are for both peak and background measurements.
6) FeO* - total iron expressed as FeO
8) Fe2+/Fe3+ calculations are based on charge balance.

All concentrations reported as wt%.

Client Project 98052
Ontario Geological Survey

Mineral Pyroxene
Sample Various
Job # 98-0644
Analyst D. Crabtree
Analyst Approved March 31st, 1999

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total
DC-1	0.25-0.5	54.12	0.07	0.89	0.19	15.62	24.16	0.08	4.20	0.58	0.00	99.92
DC-2	0.25-0.5	54.15	0.07	1.29	0.37	17.05	22.35	0.17	4.38	0.47	0.02	100.32
DC-3	0.25-0.5	53.63	0.32	0.96	1.22	18.09	19.07	0.15	5.63	0.50	0.00	99.57
DC-4	0.25-0.5	53.90	0.33	0.88	1.18	18.16	19.08	0.14	5.40	0.48	0.01	99.56
DC-5	0.25-0.5	52.30	0.32	3.38	0.79	16.23	24.06	0.07	2.87	0.22	0.00	100.24
DC-6	0.25-0.5	54.69	0.04	1.40	0.43	15.15	23.69	0.10	4.03	1.13	0.00	100.66
DC-7	0.25-0.5	54.59	0.15	1.88	2.10	15.86	21.60	0.04	2.16	1.66	0.00	100.04
DC-8	0.25-0.5	53.64	0.23	1.21	0.86	17.61	21.09	0.15	4.80	0.23	0.00	99.82
DC-10	0.25-0.5	53.92	0.28	0.86	1.19	19.04	17.96	0.19	5.74	0.50	0.00	99.68
DC-11	0.25-0.5	52.47	0.17	3.24	0.90	17.92	21.37	0.10	3.24	0.20	0.00	99.61
DC-12	0.25-0.5	54.28	0.08	1.68	0.83	16.37	23.33	0.12	3.20	0.56	0.00	100.45
DC-13	0.25-0.5	53.82	0.14	1.34	0.91	18.35	22.47	0.05	2.45	0.18	0.00	99.71
DC-15	0.25-0.5	53.73	0.12	1.71	1.10	18.42	21.91	0.04	2.50	0.22	0.00	99.76
DC-16	0.25-0.5	54.38	0.00	0.49	0.24	15.72	24.69	0.14	4.34	0.35	0.00	100.35
DC-17	0.25-0.5	53.24	0.17	2.70	1.23	18.07	20.92	0.08	3.15	0.43	0.00	99.99
DC-18	0.25-0.5	54.34	0.08	1.11	1.11	16.21	23.20	0.10	3.17	0.77	0.01	100.10
DC-19	0.25-0.5	54.37	0.03	1.37	0.85	16.32	23.13	0.08	3.35	0.58	0.00	100.08

All concentrations reported as wt%.

Client	**Project 98052**		**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey		**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Pyroxene**		Data reviewed by Dave Crabtree
Sample	**Various**		
Job #	**98-0644**		
Analyst	**D. Crabtree**		
Analyst Approved	**March 31st, 1999**		

QUALITY CONTROL

Analytical Conditions:	**20kV, 15nA, spot size 3-5 microns.**
Routine:	**Pyroxene Routine - Combined EDS/WDS aquisition.**
Correction Procedure:	**ZAF-4**

Important note:

Due to variations in LOD and LOQ with sample matrix, these values are approximated in this report. Precision is best when data exceed the LOQ.
The Geoscience Laboratories tracks long and short term precision on a variety of mineral standards. If you have any specific requirements please contact us.

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total
ampKNZ		39.57	5.04	14.82	0.01	12.26	9.93	0.09	10.88	2.47	2.02	97.10
ampKNZ		40.19	4.93	15.08	0.01	12.48	10.09	0.12	10.74	2.50	2.02	98.16
diopAST		55.28	0.04	0.00	0.01	18.49	25.94	0.04	0.05	0.01	0.00	99.86
diopAST		55.53	0.02	0.00	0.03	18.39	26.06	0.07	0.10	0.01	0.00	100.21
pyxBRN		50.46	0.45	7.89	0.87	17.14	17.18	0.18	4.73	0.83	0.00	99.73
pyxBRN		50.24	0.57	7.93	0.89	17.21	17.19	0.13	4.90	0.82	0.00	99.88
Standard		pyxBRN	pyxBRN	pyxBRN	pyxBRN	pyxBRN	pyxBRN	pyxBRN	pyxBRN	pyxBRN	ampKNZ	
Average wt%		50.35	0.51	7.91	0.88	17.18	17.19	0.16	4.82	0.82	2.02	
Expected wt% *		50.48	0.48	7.82	0.90	17.32	17.30	0.13	4.71	0.84	2.10	
Trueness % rel.		-0.26	6.25	1.15	-2.22	-0.84	-0.66	19.23	2.23	-2.20	-3.81	
								note#4				
Mode		EDS	WDS	EDS	WDS	EDS	EDS	WDS	EDS	WDS	WDS	
L.O.D. wt%		0.121	0.029	0.142	0.024	0.123	0.068	0.022	0.104	0.010	0.008	
L.O.Q. wt%		0.403	0.097	0.473	0.080	0.410	0.227	0.073	0.347	0.033	0.027	
Count time (seconds)		120	20	120	20	120	120	20	120	60	60	

* Expected Values are from long term in-house charcterization of mineral standards.

QC note

All concentrations reported as wt%.

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Client	**Project 98052**
	Ontario Geological Survey
Mineral	**Pyroxene**
Sample	**Various**
Job #	**98-0644**
Analyst	**D. Crabtree**
Analyst Approved	**March 31st, 1999**

Sample	Size	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	Na2O	K2O	Total

1) None of the reported values for these mineral standards are certified:" trueness" is therefore based on available chemical data.
2) n.d. not determined for the specified mineral standard.
3) L.O.D. = Limit of Detection, precision ~ +/- 100%.
4) L.O.Q. = Limit of quantification (3.3 x L.O.D), precision ~ 10-30%.
5) Reported count times are for both peak and background measurements.
6) All results are for samples as received.

All concentrations reported as wt%.

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

Client	**Project 98052**
	Ontario Geological Survey
Mineral	**Ilmenite**
Sample	**Various**
Job #	**98-0644**
Analyst	**D. Crabtree**
Analyst Approved	**March 31st, 1999**

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
CR-12	0.25-0.5	0.02	50.98	0.01	0.04	0.02	0.01	0.70	0.65	47.57	0.00	0.00	100.01	3.99	43.98	100.41
CR-47	0.25-0.5	0.00	51.97	0.01	0.08	0.05	0.12	2.39	0.47	44.18	0.00	0.00	99.27	2.20	42.20	99.49
CR-171	0.25-0.5	0.00	51.85	0.09	0.12	0.01	0.10	2.42	0.53	44.82	0.03	0.02	100.00	3.15	41.98	100.31
IM-1	0.25-0.5	0.00	52.52	0.00	0.00	0.02	0.00	0.22	3.12	44.77	0.04	0.00	100.69	1.25	43.64	100.81
IM-2	0.25-0.5	0.02	51.52	0.01	0.03	0.00	0.03	0.19	0.71	47.28	0.01	0.00	99.80	2.14	45.35	100.01
IM-3	0.25-0.5	0.00	51.91	0.00	0.01	0.01	0.06	0.79	0.60	47.06	0.01	0.06	100.51	2.62	44.70	100.77
IM-4	0.25-0.5	0.01	52.17	0.02	0.10	0.03	0.25	2.33	0.47	45.12	0.03	0.00	100.53	2.70	42.69	100.80
IM-5	0.25-0.5	0.01	51.70	0.00	0.10	0.04	0.21	2.14	0.51	45.46	0.00	0.02	100.20	3.31	42.48	100.53

All concentrations reported as wt%.

Client	Project 98052
	Ontario Geological Survey
Mineral	Ilmenite
Sample	Various
Job #	98-0644
Analyst	D. Crabtree
Analyst Approved	March 31st, 1999

GEOSCIENCE LABORATORIES REPORT
ELECTRON MICROPROBE ANALYSIS
Data reviewed by Dave Crabtree

QUALITY CONTROL

Analytical Conditions:	**20kV, 15nA, spot size 1-3 microns.**
Routine:	**Custom EDS/WDS ilmenite routine.**
Correction Procedure:	**ZAF-4 with off-line correction for Tikb-Vka (LiF) and Crkb-Mnka (PET)**

Important note:

Due to variations in LOD and LOQ with sample matrix, these values are approximated in this report. LOD's for EDS data represent the best case scenario (i.e. no peak overlaps)
Precision is best when data exceed the LOQ.The Geoscience Laboratories tracks long and short term precision on a variety of mineral standards.
If you have any specific requirements please contact us.

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total
chrRV1		0.02	0.39	0.00	8.86	62.49	0.18	13.35	0.29	13.47	0.08	0.09	99.22	0.51	13.01	99.27
gahBRZ		0.05	0.03	0.00	55.43	0.00	0.02	0.00	0.32	2.07	0.03	42.03	99.98	0.17	1.92	100.00
ilmMSU		0.01	47.06	0.98	0.03	0.01	0.09	0.29	4.50	46.18	0.00	0.02	99.17	8.60	38.44	100.03
Standard		chrRV1	ilmMSU	ilmMSU	chrRV1	chrRV1	chrRV1	chrRV1	ilmMSU	ilmMSU	chrRV1	gahBRZ				
Average wt%		L.O.D.	47.060	0.980	8.860	62.490	L.O.D.	13.350	4.500	46.180	L.O.D.	42.030				
Expected wt% *		L.O.D.	46.756	0.980	8.900	62.850	L.O.D.	13.840	4.600	46.419	L.O.D.	41.870				
Trueness % rel.			0.650	0.000	-0.449	-0.573		-3.540	-2.174	-0.515		0.382				
Mode		WDS	EDS	WDS	WDS	WDS	WDS	WDS	WDS	EDS	WDS	WDS				
XTAL		TAP	Si(Li)	PET	TAP	PET	LiF	TAP	PET	Si(Li)	LiF	LiF				
L.O.D. wt%		0.024	0.084	0.066	0.024	0.030	0.052	0.016	0.040	0.100	0.038	0.054				
L.O.Q. wt%		0.080	0.280	0.220	0.080	0.100	0.173	0.053	0.133	0.333	0.127	0.180				
Count time (seconds)		25	130	25	25	25	25	25	25	130	25	25				

** Expected Values are from long term in-house charcterization of mineral standards.

QC note

1) None of the reported values for these mineral standards are certified:" trueness" is therefore based on available chemical data.
2) n.d. not determined for the specified mineral standard.

GEOSCIENCE LABORATORIES REPORT

ELECTRON MICROPROBE ANALYSIS

Data reviewed by Dave Crabtree

Client	**Project 98052**
	Ontario Geological Survey
Mineral	**Ilmenite**
Sample	**Various**
Job #	**98-0644**
Analyst	**D. Crabtree**
Analyst Approved	**March 31st, 1999**

Sample	Size	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO*	NiO	ZnO	Total	Fe2O3	FeO	Total

3) L.O.D. = Limit of Detection, precision ~ +/- 100%.

4) L.O.Q. = Limit of quantification (3.3 x L.O.D), precision ~ 10-30%.

5) Reported count times are for both peak and background measurements.

6) FeO* - total Iron expressed as FeO

8) Fe2+/Fe3+ calculations are based on charge balance.

All concentrations reported as wt%.

Client	**Project 98052**	**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey	**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Gahnite**	Data reviewed by Dave Crabtree
Sample	**Various**	
Job #	**98-0644**	
Analyst	**D. Crabtree**	
Analyst Approved	**March 31st, 1999**	

Sample	Size (mm)	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO	NiO	ZnO	Total	Fe2O3	FeO	Total
GA-1	0.25-0.5	0.02	0.02	0.04	57.22	0.01	0.03	2.57	0.57	7.72	0.02	32.25	100.48	0.59	7.19	100.54
GA-2	0.25-0.5	0.01	0.01	0.07	55.51	0.00	0.00	0.75	0.04	4.05	0.02	39.13	99.59	0.52	3.58	99.65
GA-3(D)	0.25-0.5	0.05	0.02	0.00	55.64	0.03	0.02	0.80	0.04	4.36	0.03	38.51	99.50	0.31	4.08	99.53
GA-3	0.25-0.5	0.01	0.01	0.00	56.10	0.12	0.00	2.06	0.14	9.09	0.00	32.51	100.04	1.46	7.78	100.19
GA-4	0.25-0.5	0.04	0.00	0.02	55.87	0.05	0.00	1.62	0.01	7.96	0.01	34.91	100.48	1.60	6.52	100.64

All concentrations reported as wt%.

Client	**Project 98052**	**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey	**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Gahnite**	Data reviewed by Dave Crabtree
Sample	**Various**	
Job #	**98-0644**	
Analyst	**D. Crabtree**	
Analyst Approved	**March 31st, 1999**	

Sample	Size (mm)	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO	NiO	ZnO	Total	Fe2O3	FeO	Total

QUALITY CONTROL

Analytical Conditions:	**20kV, 20nA, spot size 1-3 microns.**
Routine:	**Custom EDS/WDS gahnite routine.**
Correction Procedure:	**ZAF-4**

Important note:

Due to variations in LOD and LOQ with sample matrix, these values are approximated in this report. LOD's for EDS data represent the best case scenario(i.e. no peak overlaps). Precision is best when data exceed the LOQ.The Geoscience Laboratories tracks long and short term precision on a variety of mineral standards. If you have any specific requirements please contact us.

	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO	NiO	ZnO	Total	Fe2O3	FeO	Total
gahBRZ	0.04	0.00	0.01	55.36	0.01	0.01	0.02	0.32	2.00	0.02	41.96	99.75	0.19	1.83	99.77
chrRV1	0.05	0.42	0.02	8.99	63.02	0.19	13.36	0.13	13.37	0.11	0.14	99.80	0.00	13.37	99.80
ilmMSU	0.02	46.84	0.99	0.17	0.03	0.10	0.30	4.71	46.72	0.06	0.04	99.98	9.72	37.98	100.95
Standard				gahBRZ				gahBRZ	gahBRZ		gahBRZ				
Average wt%	L.O.D.	L.O.D.	L.O.D.	55.360	L.O.D.	L.O.D.	L.O.D.	0.320	2.000	L.O.D.	41.960				
Expected wt% *				55.790				0.380	1.970		41.870				
Trueness % rel.				-0.771				-15.789	1.523		0.215				
Mode	WDS	WDS	WDS	EDS	WDS	WDS	WDS	WDS	EDS	WDS	EDS				
L.O.D. wt%	0.040	0.040	0.100	0.155	0.050	0.090	0.040	0.050	0.114	0.070	0.160				
L.O.Q. wt%	0.133	0.133	0.333	0.517	0.167	0.300	0.133	0.167	0.380	0.233	0.533				
Count time (seconds)	20	15	15	100	15	15	20	15	100	15	100				

** Expected Values are from long term in-house charcterization of mineral standards.

All concentrations reported as wt%.

Client	**Project 98052**	**GEOSCIENCE LABORATORIES REPORT**
	Ontario Geological Survey	**ELECTRON MICROPROBE ANALYSIS**
Mineral	**Gahnite**	Data reviewed by Dave Crabtree
Sample	**Various**	
Job #	**98–0644**	
Analyst	**D. Crabtree**	
Analyst Approved	**March 31st, 1999**	

Sample	Size (mm)	SiO2	TiO2	Nb2O5	Al2O3	Cr2O3	V2O5	MgO	MnO	FeO	NiO	ZnO	Total	Fe2O3	FeO	Total

QC note

1) None of the reported values for these mineral standards are certified:" trueness" is therefore based on available chemical data.
2) n.d. not determined for the specified mineral standard.
3) L.O.D. = Limit of Detection, precision ~ +/– 100%.
4) L.O.Q. = Limit of quantification (3.3 x L.O.D), precision ~ 10–30%.
5) Reported count times are for both peak and background measurements.
6) FeO* – total Iron expressed as FeO

All concentrations reported as wt%.

Appendix G: **Matrix Grainsize and Heavy Mineral Analysis of Selected Samples.**

Explanations:

1) Statistical results and descriptions in the second table were determined using the methodology of Folk (1980).

Sample_no.	Material	Easting	Northing	%_vc_sand	%_c_sand	%_m_sand	%_f_sand	%_vf_sand	total_sand_(%)	%_silt	%_clay	%_heavy_mineral	%_magnetics
98-PJB-1-1-2	ice-contact stratified sediment	470540	5232430	14.7	45.7	27.8	7.5	2.5	98.1	1.9	0.0	11.1	23.5
98-PJB-2-1-2	outwash	505550	5169040	25.4	52.7	18.5	3.3	0.0	99.8	0.2	0.0	11.3	13.6
98-PJB-2-2-2	outwash	505550	5169040	9.0	48.3	39.9	2.6	0.2	100.0	0.0	0.0	12.3	18.5
98-PJB-2-3-2	outwash	505550	5169040	0.1	0.4	66.2	30.4	3.0	100.0	0.0	0.0	1.0	24.3
98-PJB-3-1-2	ice-contact stratified sediment	504870	5172720	10.6	20.6	51.5	9.7	2.6	94.9	5.1	0.0	8.1	17.2
98-PJB-4-1-2	outwash	505690	5172150	18.7	22.5	46.8	6.3	2.4	96.7	3.3	0.0	11.2	14.4
98-PJB-5-1-2	ice-contact stratified sediment	491760	5186955	34.5	42.7	19.9	2.4	0.2	99.7	0.3	0.0	10.9	4.6
98-PJB-6-1-2	ice-contact stratified sediment	487875	5189030	29.9	38.8	23.5	4.2	2.0	98.2	1.8	0.0	12.9	7.2
98-PJB-7-1-2	ice-contact stratified sediment	483580	5188080	31.6	38.4	22.4	3.8	2.0	98.1	1.9	0.0	19.2	2.9
98-PJB-8-1-2	outwash	503170	5184850	12.6	33.6	39.1	8.3	3.0	96.6	3.4	0.0	8.0	18.6
98-PJB-9-1-2	outwash	494260	5191170	8.3	8.3	45.1	25.9	9.7	97.3	2.7	0.0	5.2	12.0
98-PJB-10-1-2	till (flowtill)	489095	5198495	5.8	11.2	26.9	18.6	14.3	76.7	23.3	0.0	3.7	11.4
98-PJB-11-1-2	outwash	483815	5206445	26.8	26.0	32.6	10.2	4.0	99.5	1.5	0.0	7.7	10.8
98-PJB-12-1-2	outwash	498980	5185625	5.8	19.8	52.3	9.2	6.3	93.4	6.7	0.0	7.7	10.8
98-PJB-13-1-2	stream sediment	502020	5175487	21.6	26.8	20.7	13.7	9.4	92.1	7.9	0.0	4.8	0.9
98-PJB-14-1-2	ice-contact stratified sediment	502620	5172535	10.5	28.1	33.2	17.4	6.7	96.0	4.0	0.0	6.6	9.6
98-PJB-15-1-2	outwash	501560	5171250	9.6	63.2	21.6	5.6	0.0	100.0	0.0	0.0	8.6	22.3
98-PJB-16-1-2	stream sediment	506550	5170875	11.8	42.8	36.9	8.9	0.0	100.3	0.0	0.0	11.9	2.0
98-PJB-21-1-2	outwash	503750	5174580	20.0	42.0	21.3	7.9	3.5	94.6	5.5	0.0	7.8	16.7
98-PJB-28-1-2	till	489300	5201060	0.7	6.0	25.2	22.0	18.4	72.3	27.7	0.0	4.3	14.4
98-PJB-31-1-2	outwash	488880	5200467	7.1	37.8	32.7	8.6	5.7	91.9	8.1	0.0	14.8	13.8
98-PJB-32-1-2	till	488230	5197350	1.9	13.6	28.2	16.0	14.7	74.3	25.7	0.0	4.0	12.5
98-PJB-33-1-2	outwash	505396	5176170	5.8	36.3	41.6	7.6	3.7	95.0	5.0	0.0	9.0	15.1
98-PJB-35-1-2	stream sediment	505685	5180670	1.2	16.8	64.4	9.4	3.4	95.3	4.7	0.0	17.0	34.2
98-PJB-43-1-2	outwash	498217	5185295	2.7	15.1	24.9	17.3	16.1	76.1	23.9	0.0	10.6	9.3
98-PJB-47-1-2	outwash	494098	5193432	1.2	20.9	61.5	7.4	4.5	95.3	4.7	0.0	18.2	35.0
98-PJB-48-1-2	outwash	493445	5192280	0.5	10.9	79.8	7.9	1.0	100.0	0.0	0.0	6.4	11.4
98-PJB-48-2-2	outwash	493445	5192280	0.5	4.4	69.0	19.3	5.5	98.7	1.3	0.0	9.4	18.8
98-PJB-49-1-2	outwash	493395	5192311	0.0	1.3	45.7	35.3	15.7	97.9	2.1	0.0	3.4	6.2
98-PBJ-49-2-2	outwash	493395	5192311	1.0	10.2	72.9	13.6	2.4	100.0	0.0	0.0	7.2	12.5
98-PJB-51-1-2	outwash	491750	5199300	11.2	18.2	44.2	10.8	4.9	89.2	10.3	0.5	12.7	24.3
98-PJB-53-1-2	outwash	490900	5198650	1.8	26.8	48.8	10.7	6.3	94.4	5.6	0.0	7.4	18.9
98-PJB-54-1-2	outwash	491750	5196750	4.7	23.8	33.6	9.5	7.6	79.1	19.9	1.0	8.4	19.3
98-PJB-55-1-2	outwash	492100	5195500	3.3	22.9	35.7	13.3	8.2	83.5	16.5	0.0	9.3	19.8
98-PJB-58-1-2	outwash	491260	5188665	2.9	34.7	34.2	13.2	7.6	92.5	7.5	0.0	7.5	13.2
98-PJB-59-1-2	till (flowtill)	490480	5187755	2.2	12.7	36.6	17.2	12.2	80.9	19.1	0.0	5.5	13.0
98-PJB-60-1-2	ice-contact stratified sediment	480168	5222839	2.8	14.5	43.0	18.9	10.1	89.2	10.9	0.0	5.7	13.9
98-PJB-61-1-2	ice-contact stratified sediment	480217	5222777	6.9	36.9	61.5	7.3	5.0	117.6	12.0	0.4	5.9	16.9
98-PJB-62-1-2	till	480245	5221745	3.7	19.5	27.2	17.6	13.2	81.2	18.1	0.8	1.5	12.1
98-PJB-63-1-2	outwash	481063	5217537	2.3	29.0	53.2	8.6	2.2	95.3	4.7	0.0	10.6	25.4
98-PJB-68-1-2	outwash	477185	5221564	6.6	33.1	36.7	9.0	5.1	90.4	9.6	0.0	8.9	17.4
98-PJB-70-1-2	outwash	475700	5223788	0.0	1.4	11.0	26.4	34.2	73.1	26.9	0.0	1.8	3.5
98-PJB-80-1-2	outwash	482758	5212270	3.3	36.0	45.9	7.9	3.7	96.8	3.2	0.0	9.0	21.6
98-PJB-81-1-2	outwash	481305	5215675	2.6	15.1	61.6	13.0	4.5	96.7	3.3	0.0	4.6	12.9
98-PJB-82-1-2	outwash	478652	5219276	2.3	31.2	54.7	9.3	1.6	99.2	0.9	0.0	7.8	15.0
98-PJB-88-1-2	outwash	483712	5208402	5.2	30.5	43.9	12.1	5.8	97.3	2.7	0.0	7.2	17.4
98-PJB-89-1-2	till	484563	5203160	1.2	9.4	18.8	15.7	16.7	61.7	37.1	1.2	3.1	6.1
98-PJB-56-1-2	outwash	503294	5186550	1.3	21.6	45.7	11.7	8.1	88.3	11.7	0.0	6.1	18.7
98-PJB-96-1-2	outwash	494918	5198463	3.7	22.6	58.9	11.4	2.5	99.1	0.9	0.0	16.8	35.5

Sample_no.	Material	Easting	Northing	Mean_(Phi)	Standard_Deviation_(Phi)	Skewness_(Phi)	Kurtosis_(Phi)	Folk_description
98-PJB-1-1-2	ice-contact stratified sediment	470540	5232430	0.85	0.92	0.2	1.27	Fine-skewed leptokutic
98-PJB-2-1-2	outwash	505550	5169040	0.45	0.68	0	0.92	Near-symmetrical mesokurtic
98-PJB-2-2-2	outwash	505550	5169040	0.88	0.57	-0.14	1.25	Coarse-skewed leptokurtic
98-PJB-2-3-2	outwash	505550	5169040	1.92	0.45	0.34	1.11	Strongly fine-skewed mesokurtic
98-PJB-3-1-2	ice-contact stratified sediment	504870	5172720	1.22	1.15	0.09	1.61	Near-symmetrical very leptokurtic
98-PJB-4-1-2	outwash	505690	5172150	0.89	1	-0.11	1.21	Coarse-skewed leptokurtic
98-PJB-5-1-2	ice-contact stratified sediment	491760	5186955	0.34	0.64	0.14	0.65	Fine-skewed very platykurtic
98-PJB-6-1-2	ice-contact stratified sediment	487875	5189030	0.48	0.9	0.32	1	Strongly fine-skewed mesokurtic
98-PJB-7-1-2	ice-contact stratified sediment	483580	5188080	0.48	0.91	0.27	0.98	Fine-skewed mesokurtic
98-PJB-8-1-2	outwash	503170	5184850	1.02	1.01	0.08	1.33	Near-symmetrical leptokurtic
98-PJB-9-1-2	outwash	494260	5191170	1.79	1.09	0.12	1.26	Fine-skewed leptokurtic
98-PJB-10-1-2	till (flowtill)	489095	5198495	2.65	1.94	0.25	1.05	Fine-skewed mesokurtic
98-PJB-11-1-2	outwash	483815	5206445	0.82	1.12	0.16	0.87	Fine-skewed platykurtic
98-PJB-12-1-2	outwash	498980	5185625	1.49	1.22	0.31	2.19	Strongly fine-skewed very leptokurtic
98-PJB-13-1-2	stream sediment	502020	5175487	1.32	1.59	0.3	0.89	Fine-skewed platykurtic
98-PJB-14-1-2	ice-contact stratified sediment	502620	5172535	1.4	1.21	0.17	1.07	Fine-skewed mesokurtic
98-PJB-15-1-2	outwash	501560	5171250	0.75	0.6	0	1.75	Near-symmetrical very leptokurtic
98-PJB-16-1-2	stream sediment	506550	5170875	0.92	0.75	-0.04	1.3	Near-symmetrical leptokurtic
98-PJB-21-1-2	outwash	503750	5174580	0.85	1.26	0.43	1.39	Strongly fine-skewed leptokurtic
98-PJB-28-1-2	till	489300	5201060	3.08	1.75	0.25	0.95	Fine-skewed mesokurtic
98-PJB-31-1-2	outwash	488880	5200467	1.35	1.35	0.4	1.43	Strongly fine-skewed leptokurtic
98-PJB-32-1-2	till	488230	5197350	2.78	1.92	0.31	0.93	Strongly fine-skewed mesokurtic
98-PJB-33-1-2	outwash	505396	5176170	1.15	1.06	0.23	1.55	Fine-skewed very platykurtic
98-PJB-35-1-2	stream sediment	505685	5180670	1.46	0.87	0.43	2.81	Strongly fine-skewed very leptokurtic
98-PJB-43-1-2	outwash	498217	5185295	2.63	1.83	0.19	0.9	Fine-skewed mesokurtic
98-PJB-47-1-2	outwash	494098	5193432	1.29	0.94	0.25	2.77	Fine-skewed very leptokurtic
98-PJB-48-1-2	outwash	493445	5192280	1.29	0.44	0.2	2.27	Fine-skewed very leptokurtic
98-PJB-48-2-2	outwash	493445	5192280	1.74	0.66	0.51	1.18	Strongly fine-skewed leptokurtic
98-PJB-49-1-2	outwash	493395	5192311	2.2	0.78	0.25	0.85	Fine-skewed platykurtic
98-PBJ-49-2-2	outwash	493395	5192311	1.45	0.58	0.35	1.92	Strongly fine-skewed very leptokurtic
98-PJB-51-1-2	outwash	491750	5199300	1.51	1.59	0.33	1.47	Strongly fine-skewed leptokurtic
98-PJB-53-1-2	outwash	490900	5198650	1.47	1.12	0.32	1.58	Strongly fine-skewed very leptokurtic
98-PJB-54-1-2	outwash	491750	5196750	2.21	2.07	0.55	1.07	Strongly fine-skewed mesokurtic
98-PJB-55-1-2	outwash	492100	5195500	2.04	1.8	0.46	1.2	Strongly fine-skewed leptokurtic
98-PJB-58-1-2	outwash	491260	5188665	1.56	1.26	0.42	1.21	Strongly fine-skewed leptokurtic
98-PJB-59-1-2	till (flowtill)	490480	5187755	2.45	1.72	0.45	1.1	Strongly fine-skewed mesokurtic
98-PJB-60-1-2	ice-contact stratified sediment	480168	5222839	1.95	1.37	0.36	1.24	Strongly fine-skewed leptokurtic
98-PJB-61-1-2	ice-contact stratified sediment	480217	5222777	1.55	1.61	0.49	1.51	Strongly fine-skewed very leptokurtic
98-PJB-62-1-2	till	480245	5221745	2.27	1.94	0.31	1.11	Strongly fine-skewed leptokurtic
98-PJB-63-1-2	outwash	481063	5217537	1.17	0.92	0.24	1.64	Fine-skewed very leptokurtic
98-PJB-68-1-2	outwash	477185	5221564	1.43	1.43	0.41	1.59	Strongly fine-skewed leptokurtic
98-PJB-70-1-2	outwash	475700	5223788	3.3	1.1	-0.05	0.96	Near-symmetrical mesokurtic
98-PJB-80-1-2	outwash	482758	5212270	1.18	0.86	0.24	1.63	Fine-skewed very leptokurtic
98-PJB-81-1-2	outwash	481305	5215675	1.53	0.9	0.3	2.12	Strongly fine-skewed very leptokurtic
98-PJB-82-1-2	outwash	478652	5219276	1.02	0.64	-0.03	1.22	Near-symmetrical leptokurtic
98-PJB-88-1-2	outwash	483712	5208402	1.32	1.03	0.22	1.16	Fine-skewed leptokurtic
98-PJB-89-1-2	till	484563	5203160	3.41	2.09	0.12	0.87	Fine-skewed platykurtic
98-PJB-56-1-2	outwash	503294	5186550	1.84	1.42	0.54	1.3	Strongly fine-skewed leptokurtic
98-PJB-96-1-2	outwash	494918	5198463	1.21	0.78	-0.03	1.54	Near-symmetrical very leptokurtic

Appendix H: **Pebble Lithology Identification.**

Explanations:

1) In the second table several rock types identified in the first table are grouped together as a summary. All metavolcanic rock types were grouped together, felsic intrusive rocks and gneisses were grouped and diamictites, quartzites, arenites and argillites were grouped as Huronian rocks.
2) Icsd is a short form for ice-contact stratified deposits.

Sample_no	Material	Easting	Northing	Total_pebbles	Mafic_metavolcanic	Felsic_metavolcanic	Mafic_intrusive	Felsic_intrusive	Diamictite	Quartzite	Arenite	Argillite	Gneiss	Vein_quartz
98-PJB-1-1-3	icsd	470540	5232430	126	13.5	1.6	23	49.2	0	0.8	1.6	1.6	7.1	1.6
98-PJB-2-1-3	outwash	505550	5169040	202	41	2.5	4.5	18.8	0	3	1.5	26.7	2	0
98-PJB-2-2-3	outwash	505550	5169040	70	25.7	2.9	1.4	28.6	0	2.9	5.7	28.6	4.2	0
98-PJB-3-1-3	icsd	504870	5172720	159	49.7	0	15.1	16.4	0	6.9	3.1	6.9	1.9	0
98-PJB-4-1-3	outwash	505690	5172150	125	42.4	6.4	17.6	10.4	0	1.6	2.4	18.4	0	0.8
98-PJB-5-1-3	icsd	491760	5186955	119	42	2.5	4.2	37	0	4.2	2.5	7.6	0	0
98-PJB-6-1-3	icsd	487875	5189030	111	26.1	3.6	6.3	46.8	0	5.5	1.8	9.9	0	0
98-PJB-7-1-3	icsd	483580	5188080	153	39.9	5.9	5.2	37.9	0	1.3	2.6	3.3	0	3.9
98-PJB-8-1-3	outwash	503170	5184850	140	25.7	7.1	15.7	18.6	0	5	0.8	25	0	2.1
98-PJB-9-1-3	outwash	494260	5191170	145	41.4	7.6	12.4	12.4	0	2	0.7	22.1	0.7	0.7
98-PJB-10-1-3	till (flowtill)	489095	5198495	114	14	4.4	4.4	65.8	0	3.5	2.6	1.8	0	3.5
98-PJB-11-1-3	outwash	483815	5206445	128	50.8	3.1	6.3	22.7	0	3.9	4.7	8.5	0	0
98-PJB-12-1-3	outwash	498980	5185625	138	25.4	5.8	2.9	38.4	0.7	3.6	0.7	22.5	0	0
98-PJB-13-1-3	stream sediment	502020	5175487	96	0	100	0	0	0	0	0	0	0	0
98-PJB-14-1-3	icsd	502620	5172535	103	35.9	5.8	6.8	40.8	0	2.9	1	4.9	0	1.9
98-PJB-15-1-3	outwash	501560	5171250	150	57.3	1.3	2.6	26	0	0	0.8	12	0	0
98-PJB-16-1-3	stream sediment	506550	5170875	99	26.3	0	1	32.3	0	11.1	5.1	19.2	0	5
98-PJB-21-1-3	outwash	503750	5174580	132	15.9	65.9	6.1	9.8	0	2.3	0	0	0	0
98-PJB-28-1-3	till	489300	5201060	133	65.4	5.3	3	15	0	3.8	2.2	3	0.8	1.5
98-PJB-31-1-3	outwash	488880	5200467	150	39.3	2	16.7	16	0	8	0.7	17.3	0	0
98-PJB-32-1-3	till	488230	5197350	108	40.7	1.9	1.9	45.3	0	2.7	1.9	3.7	0	1.9
98-PJB-33-1-3	outwash	505396	5176170	133	47.4	7.5	15.8	18	0	3.7	1.5	5.3	0	0.8
98-PJB-35-1-3	outwash	505685	5180670	122	39.3	6.6	4.1	25.4	0	5.7	3.3	14	0	1.6
98-PJB-43-1-3	till (flowtill)	498217	5185295	118	71.2	0.8	3.4	15.2	0	0.9	0	4.2	0.9	3.4
98-PJB-47-1-3	outwash	494098	5193432	105	29.5	10.5	11.4	21	0	4.8	4.8	16	1	1
98-PJB-48-1-3	outwash	493445	5192280	104	31.7	3.8	0	44.2	1	0	4.8	12.5	0	2
98-PJB-48-2-3	outwash	493445	5192280	135	24.4	3	3	45.2	0	3.7	2.2	13.3	0.8	4.4
98-PJB-49-2-3	outwash	493395	5192311	114	22.8	6.1	4.4	32.5	0	0.9	7.9	21	1.8	2.6
98-PJB-51-1-3	outwash	491750	5199300	108	44.4	10.2	8.3	13.9	0	3.7	0	17.6	0	1.9
98-PJB-53-1-3	outwash	490900	5198650	99	23.3	2	4	48.5	1	5	4	10.2	0	2
98-PJB-54-1-3	outwash	491750	5196750	101	38.6	6.9	5.9	32.7	0	5	1	8.9	0	1
98-PJB-55-1-3	outwash	492100	5195500	106	47.2	13.2	13.2	13.2	0	0.9	2	8.5	0.9	0.9
98-PJB-56-1-3	outwash	503294	5186550	98	29.6	9.2	10.2	23.5	1	5.1	1	18.4	1	1
98-PJB-58-1-3	outwash	491260	5188665	109	48.6	7.3	8.3	22.9	0	4.6	0.9	3.7	0.9	2.8
98-PJB-59-1-3	till (flowtill)	490480	5187755	120	35	1.7	3.3	39.3	0	8.3	0.8	10	0.8	0.8
98-PJB-60-1-3	icsd	480168	5222839	112	20.5	2.7	8	27.7	0	9.8	13.4	13.4	0.9	3.6
98-PJB-61-1-3	icsd	480217	5222777	136	40.4	5.1	27.9	7.4	0	3	4.4	8.8	0.8	2.2
98-PJB-62-1-3	till	480245	5221745	118	37.3	0	3.5	50.8	0	3.4	3.4	0.8	0.8	0
98-PJB-63-1-3	outwash	481063	5217537	116	36.2	7.8	10.3	24.1	0.9	2.6	1.7	15.5	0	0.9
98-PJB-68-1-3	outwash	477185	5221564	125	22.4	5.6	8.8	34.4	0	0.8	1.6	24.8	1.6	0
98-PJB-80-1-3	outwash	482758	5212270	113	35.4	4.4	3.5	25.7	0	5.3	4.4	17.7	0.9	2.7
98-PJB-81-1-3	outwash	481305	5215675	105	31.4	8.6	5.7	41.8	0	1	1	10.5	0	0
98-PJB-82-1-3*	outwash	478652	5219276	101	34.6	4	3	34.6	0	2	0	18.8	2	0
98-PJB-88-1-3	outwash	483712	5208402	106	36.8	2.8	2.8	31.2	0	4.7	4.7	17	0	0
98-PJB-89-1-3	till	484563	5203160	91	36.3	8.8	6.6	26.4	0	4.4	3.3	12	0	2.2

* contains 1% Carbonate rock fragments

Sample_no	Material	Easting	Northing	Total_pebbles	Metavolcanic	Mafic_intrusive	Felsic_intrusive_and_metamorphic	Huronian	Vein_quartz/feldspar
98-PJB-1-1-3	icsd	470540	5232430	126	15.1	23	56.3	4	1.6
98-PJB-2-1-3	outwash	505550	5169040	202	43.5	4.5	20.8	31.2	0
98-PJB-2-2-3	outwash	505550	5169040	70	28.6	1.4	32.8	37.2	0
98-PJB-3-1-3	icsd	504870	5172720	159	49.7	15.1	18.3	16.9	0
98-PJB-4-1-3	outwash	505690	5172150	125	48.8	17.6	10.4	22.4	0.8
98-PJB-5-1-3	icsd	491760	5186955	119	44.5	4.2	37	14.3	0
98-PJB-6-1-3	icsd	487875	5189030	111	29.7	6.3	46.8	17.2	0
98-PJB-7-1-3	icsd	483580	5188080	153	45.8	5.2	37.9	7.2	3.9
98-PJB-8-1-3	outwash	503170	5184850	140	32.8	15.7	18.6	30.8	2.1
98-PJB-9-1-3	outwash	494260	5191170	145	49	12.4	13.1	24.8	0.7
98-PJB-10-1-3	till (flowtill)	489095	5198495	114	18.4	4.4	65.8	7.9	3.5
98-PJB-11-1-3	outwash	483815	5206445	128	53.9	6.3	22.7	17.1	0
98-PJB-12-1-3	outwash	498980	5185625	138	31.2	2.9	38.4	27.5	0
98-PJB-13-1-3	stream sediment	502020	5175487	96	100	0	0	0	0
98-PJB-14-1-3	icsd	502620	5172535	103	41.7	6.8	40.8	8.8	1.9
98-PJB-15-1-3	outwash	501560	5171250	150	58.6	2.6	26	12.8	0
98-PJB-16-1-3	stream sediment	506550	5170875	99	26.3	1	32.3	35.4	5
98-PJB-21-1-3	outwash	503750	5174580	132	81.8	6.1	9.8	2.3	0
98-PJB-28-1-3	till	489300	5201060	133	70.7	3	15.8	9	1.5
98-PJB-31-1-3	outwash	488880	5200467	150	41.3	16.7	16	26	0
98-PJB-32-1-3	till	488230	5197350	108	42.6	1.9	45.3	8.3	1.9
98-PJB-33-1-3	outwash	505396	5176170	133	54.9	15.8	18	10.5	0.8
98-PJB-35-1-3	outwash	505685	5180670	122	45.9	4.1	25.4	23	1.6
98-PJB-43-1-3	till (flowtill)	498217	5185295	118	72	3.4	16.1	5.1	3.4
98-PJB-47-1-3	outwash	494098	5193432	105	40	11.4	22	25.6	1
98-PJB-48-1-3	outwash	493445	5192280	104	35.5	0	44.2	18.3	2
98-PJB-48-2-3	outwash	493445	5192280	135	27.4	3	46	19.2	4.4
98-PJB-49-2-3	outwash	493395	5192311	114	28.9	4.4	34.3	29.8	2.6
98-PJB-51-1-3	outwash	491750	5199300	108	54.6	8.3	13.9	21.3	1.9
98-PJB-53-1-3	outwash	490900	5198650	99	25.3	4	48.5	20.2	2
98-PJB-54-1-3	outwash	491750	5196750	101	45.5	5.9	32.7	14.9	1
98-PJB-55-1-3	outwash	492100	5195500	106	60.4	13.2	14.1	11.4	0.9
98-PJB-56-1-3	outwash	503294	5186550	98	38.8	10.2	24.5	25.5	1
98-PJB-58-1-3	outwash	491260	5188665	109	55.9	8.3	23.8	9.2	2.8
98-PJB-59-1-3	till (flowtill)	490480	5187755	120	36.7	3.3	40.1	19.1	0.8
98-PJB-60-1-3	icsd	480168	5222839	112	23.2	8	28.6	36.6	3.6
98-PJB-61-1-3	icsd	480217	5222777	136	45.5	27.9	8.2	16.2	2.2
98-PJB-62-1-3	till	480245	5221745	118	37.3	3.5	51.6	7.6	0
98-PJB-63-1-3	outwash	481063	5217537	116	44	10.3	24.1	20.7	0.9
98-PJB-68-1-3	outwash	477185	5221564	125	28	8.8	36	27.2	0
98-PJB-80-1-3	outwash	482758	5212270	113	39.8	3.5	26.6	27.4	2.7
98-PJB-81-1-3	outwash	481305	5215675	105	40	5.7	41.8	12.5	0
98-PJB-82-1-3*	outwash	478652	5219276	101	38.6	3	36.6	20.8	0
98-PJB-88-1-3	outwash	483712	5208402	106	39.6	2.8	31.2	26.4	0
98-PJB-89-1-3	till	484563	5203160	91	45.1	6.6	26.4	19.7	2.2

* contains 1 % carbonate rock fragments

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 90**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

MAPS NOT FILMED

CARTES NON REPRODUITES